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NATIONAL MUSEUM MELBOURNE 31.7.22.

# The Journal of the Department of Agriculture of Victoria, Australia.

July, 1922.

## PRINCIPAL CONTENTS

Present and Probable Future Distribution of Wheat, Sheep, and Cattle in Australia

Maize Growing

Crop and Fallow Competitions

Weeds and Their Eradication

Some Wine Defects

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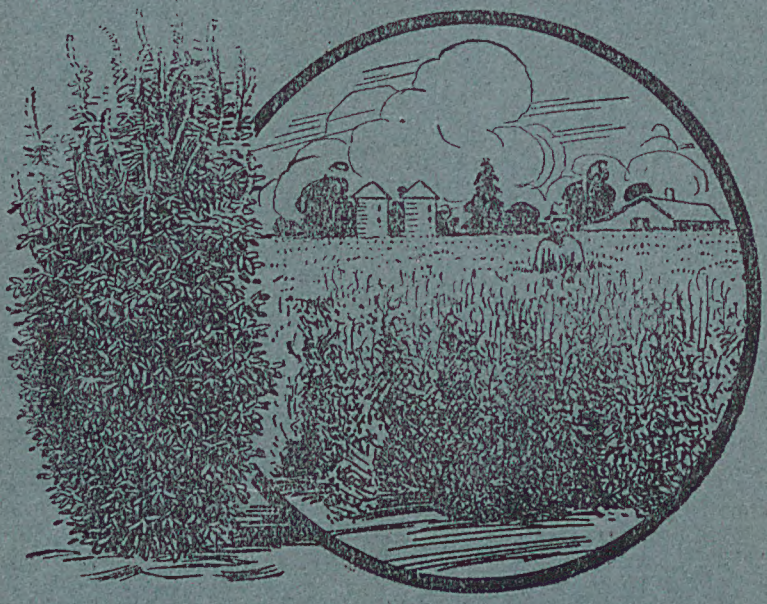

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## CONTENTS.—JULY, 1922.


| | | PAGE |
|---|---|---|
| Present and Probable Future Distribution of Wheat, Sheep, and Cattle in Australia | *R. G. Thomas, B.Ag.Sc.* | 385 |
| The Snowy River Flats at Orbost | *L. C. Bartels, B.Ag.Sc.* | 393 |
| Crop and Fallow Competition, Horsham, 1921 | *H. A. Mullett, B.Ag.Sc.* | 400 |
| Benalla Fallow Competition, 1921 | *H. A. Mullett, B.Ag.Sc.* | 406 |
| Weeds and their Eradication (continued from page 365)—[The Bracken Fern] | *H. W. Davey, F.E.S.* | 411 |
| Potato Experiments, 1921–1922 | *J. T. Ramsay* | 415 |
| Casse (Wine Defects not directly caused by Micro-Organisms) | *F. de Castella* | 418 |
| World's Poultry Congress | *A. V. D. Rintoul, N.D.D.* | 432 |
| A Cheap Pen for Single Testing Hens | *W. C. Rugg* | 436 |
| Brown Rot of Stone Fruits | *W. Laidlaw, B.Sc., and C. C. Brittlebank* | 442 |
| Second Grade Cream (Two Common Causes) | *F. Fincher* | 443 |
| Orchard and Garden Notes | *E. E. Pescott, F.L.S.* | 444 |
| Reminders for August | | 447 |



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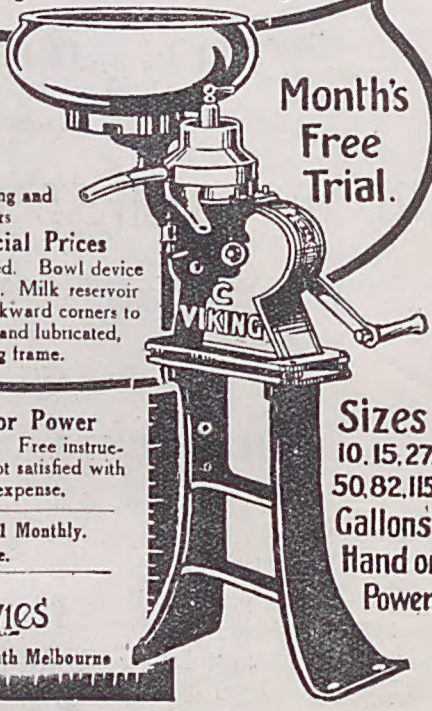


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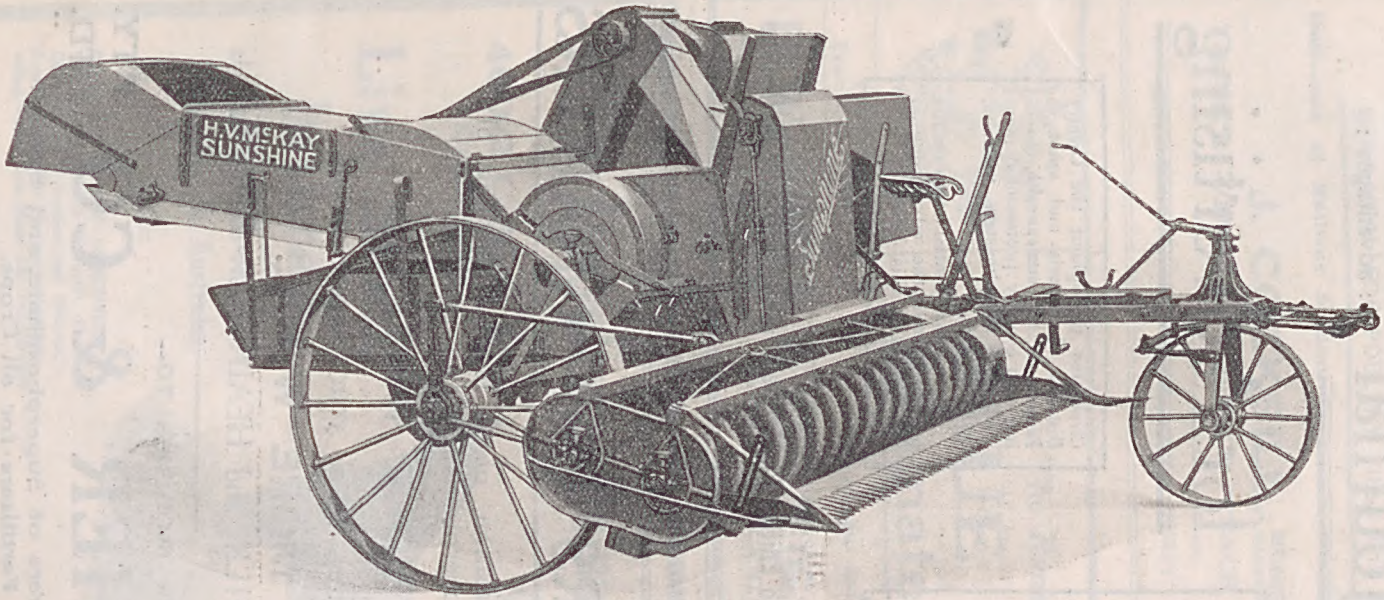


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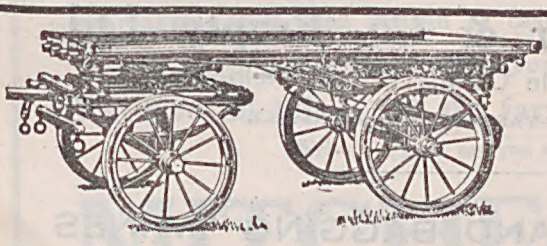

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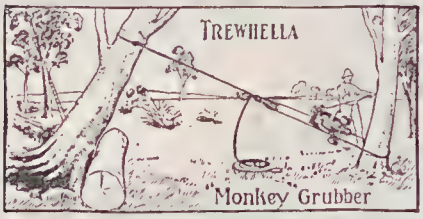


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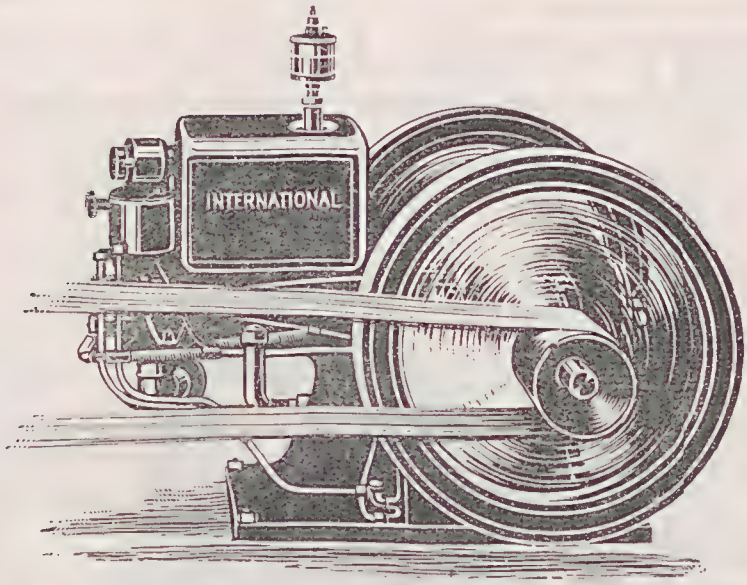


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THE JOURNAL

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Vol. XX. July, 1922. Part 7.

# PRESENT AND PROBABLE FUTURE DISTRIBUTION OF WHEAT, SHEEP, AND CATTLE IN AUSTRALIA.*

*By R. G. Thomas, B.Ag.Sc., Science Field Officer.*

Australia being essentially an agricultural and pastoral country, it was thought that considerable interest would attach to any method which would graphically and accurately represent the distribution throughout the continent of the units of the main primary industries; further, that such might give some insight into the possibilities of extending the various industries beyond their present boundaries and the direction in which such extension is likely to take place. With this object in view the accompanying maps were prepared showing the distribution of the units of the three principal primary industries, viz., sheep, cattle, and wheat, in Australia (referring here and in all statistics to the continent of Australia, excluding Tasmania). The method adopted has been to represent a certain number of head of stock or acres of wheat by a dot placed on the map as near as possible to their situation, as indicated by official statistics; this gives a more accurate representation of the distribution than can be obtained by differential shading or colouring. Each dot represents respectively 5,000 acres of wheat, 10,000 head of sheep, and 1,000 head of cattle; these quotas are small enough to show a relatively sparse distribution, yet without showing too great an area where the dots run together, and no differentiation can be shown in the areas of concentration of the respective units. The statistics used were those for the year 1918-19, being the latest typical season for which details of all the States were available at the time the work was commenced.

Similar maps have been prepared by the United States Department of Agriculture, but it is hoped that, so far as Australia is concerned, those now published are not only based on later records, but more

* Read before Royal Society of Victoria.

accurately represent the actual distribution of the units throughout the country.

Embodied in the maps are certain meteorological data relating to rainfall and temperature; such information is necessary for adequate consideration of the factors affecting the present distribution and probable extension of the industries. The data given consist of various isotherms (*i.e.*, lines of equal mean annual temperature) with the 5, 10, 20, 30, 40, and 60-in. isohyets (*i.e.*, lines of average annual rainfall) in the case of the two stock maps; and for the wheat map, the 5, 7.5, 10, 15, and 20-in. lines of winter rainfall, or more strictly the rainfall during the growing period of the crop, *i.e.*, April to October inclusive.

Acknowledgment is here made to the Government Statists of the various States and the Department of Home and Territories for supplying the statistics necessary to the work, and to the Commonwealth Meteorological Bureau for meteorological data used.

## Wheat.

The total area sown to wheat for grain and hay in Australia, for the season 1918-19, was 9,647,433 acres, and of this total New South Wales contributed 3,227,374, South Australia 2,571,208, Victoria 2,488,810, Western Australia 1,336,502, and Queensland 23,539 acres. This area represented approximately 3.5 per cent. of the total area that year sown to wheat throughout the world. Until the last four seasons, which have shown a decline due to abnormal labour and marketing conditions, there had been a steady expansion of wheat growing in Australia, her production increasing from 1.6 per cent. of that of the world in 1906-07 to 4.8 per cent. in 1916-17, and it is hoped to show that there is ample room for this extension to continue.

In considering the distribution of the area as shown by the map (Plate I.), the most striking feature is the very limited extent of the wheat-growing country. There is, indeed, a distinct wheat belt forming a crescent-shaped area some distance inland from, and approximately parallel to, the south-eastern coast line, approaching and broken by the coast line as the latter turns northwards along South Australia, and continued again as a similar belt back from the south-western coast of Western Australia.

The factors limiting the distribution of the wheat acreage may be classed under two heads—natural and political or economic. The chief natural factors are the soil and climatic conditions of rainfall and temperature. The soil within any climatic region will vary widely in fertility, but it is safe to say that, within the regions to be indicated as suitable and not yet used for wheat production, though there are areas of low-soil fertility, there are many thousands of acres of which the soil is eminently suited to the growth of wheat; of the other two factors, rainfall and temperature, the rainfall, both in its total amount and incidence in respect to the growing period of wheat, is far the more important. Temperature, in fact, can be almost disregarded as a limiting factor; there is no extensive area of cultivable land in Australia which is actually too cold for the growth of wheat, though in our cooler districts various conditions combine to make it less profitable to grow wheat than other crops. Similarly, though wheat is not grown north of

**Plate 1.—Distribution of Wheat Acreage in Australia.**

Each dot represents 5,000 acres.
Lines of average "winter rainfall" shown thus ———— ———— ————
Lines of average mean annual temperature shown thus — — — —
Lines showing probable inland limit of wheat belt as indicated by climatic conditions comparable to the present furthest inland areas under crop, shown thus × – × – ×

the 70 deg. isotherm, there is a considerable area north of this line climatically similar to the wheat-growing areas of India.* Here, again, it is the question of the degree of profitableness as compared with other agricultural and pastoral pursuits under our present conditions of development, rather than temperature, which limits the extension of the wheat area in a northerly direction. At the same time there is evidently an optimum condition of temperature for wheat in Australia, as practically the whole of the area sown to wheat is situated between the 60 and 65 deg. F. isotherms, there being a marked coincidence between the 60 deg. isotherm and the southern limit of the wheat belt.

Considering the distribution of acreage in relation to the more important factor of rainfall: the rain of importance to wheat is that received during the growing period of the crop, *i.e.*, April-October, inclusive, the rain falling through the summer being largely lost by evaporation, and also sometimes tending to reduce the wheat yield by causing lodging of the crop and the spread of rust. Therefore the lines of rainfall shown are those for this period. It is seen that practically all our wheat is now grown between the lines of 7.5 and 15 inches of winter rainfall. In Western Australia there is certainly a considerable area between the 15 and 20-inch lines, but here settlement is so sparse that more intensive agriculture has not yet pushed the wheat belt back into its true sphere in the dry-farming regions. In South Australia, Victoria, and New South Wales, the 15-in. line corresponds very closely with the southern boundary of the wheat belt, this line approximately separating the dry-farming areas from the closer settlement country, where more intensive farming is possible. The 10-in. line of winter rainfall has usually been regarded as the safe limit for wheat growing, but in South Australia and Victoria wheat is grown over a very considerable area inside this line, extending to and even passing the 7.5-in. line. The wheat-growing districts about Edeowie and Morgan, in South Australia, and immediately south of Mildura, in Victoria, are beyond the 7.5-in. line of winter rainfall; while between the 10 and 7.5-in. lines are the older settled Mallee districts of Veitch, Ouyen, and Swan Hill, where wheat growing has been an established and successful industry for over ten years. It can be fairly assumed then that country having a winter rainfall of somewhat under 7.5 inches, of reliablity equal to that in the areas indicated, and an average temperature not greatly above that of these areas, is capable of growing wheat under our present methods of cultivation and economic conditions of price of wheat, land, and labour. In New South Wales, the 10-in. line has not yet been passed, and it would seem that in the northern portion of the State it does indicate the probable limit of the wheat belt. The greater variability of the rainfall and the higher temperature, causing increased loss by evaporation, make a given average rainfall less efficient in crop production here than a similar amount in the cooler and more reliable rainfall areas in the southern portion of the State.

It is difficult indeed to indicate the ultimate inland limits of the wheat belt in Australia, for with improved drought-resistant varieties and better methods of cultivation, new areas are being brought under

* *Vide* Griffith Taylor—"The Australian Environment."

crop which but a few years previously it was thought impossible to successfully cultivate. This increasing efficiency will, it is hoped, continue. But, even with our present knowledge, there is ample room for expansion before what may be termed the probable limits of the wheat belt in the more immediate future are reached. The line shown thus — x — x — is an arbitrary line indicating what appears, from climatic considerations, to be such probable limit, and it is seen to enclose immense tracts beyond the present limits of development.

Commencing on the 10-inch winter rainfall line, south of Shark's Bay, Western Australia, where the variability of the rainfall is too great to warrant an extension to the 7.5-inch line, it passes west beyond the 7.5 line as the more reliable rainfall along the southern coast is reached. In this State alone we see a vast area of country awaiting exploitation, the greater portion of it having a winter rainfall equal in reliability and total amount to the well-developed wheat belt in Victoria. Along the west coast of South Australia this reliability of rainfall still holds, and here again might be expected a development beyond the 7.5 inch line, as has already occurred in the regions of less reliable rainfall about Edeowie. Passing over the extension of the belt north of Spencer's Gulf, the line turns southwards and runs somewhat north of the Murray and approximately parallel to the 7.5-inch line to about Ivanhoe, New South Wales, enclosing the immense tract of fertile Riverina country. Thence the line passes north-east beyond the 10-inch line, and north to St. Lawrence on the Queensland coast. As previously stated, the greater variability and higher temperature make the actual rainfall less effective than in the southern areas; hence this marked departure from the 7.5-inch line. As to the probable northerly limits of the belt, although there is a considerable area shown with a sufficient winter rainfall and where wheat can doubtless be grown, yet it seems unlikely that any considerable amount will be grown north of the Darling Downs, the high temperature, ample rainfall and its summer incidence combining to make wheat less profitable than other crops.

The present wheat belt as shown extends over an area of some 124,000,000 acres, of which only one acre in fifteen, or a total of nearly 8,000,000 acres, was under wheat in 1918-19. Since none of this is mountainous country and wheat is everywhere the principal crop, it might be expected that the area at present sown will be about trebled before this belt is utilized to anything like its full capacity. But apart from this area, there is in the probable wheat belt indicated further inland an area of some 138,000,000 acres. Assuming that this area can be developed only to the same extent as at present obtains in the Victorian Mallee, which is indeed a reasonable assumption when it is remembered that twenty years ago the advisability of abandoning the Mallee for settlement was seriously considered, and that even now but a relatively small portion of it is developed to any extent, this area would then carry a population of some 570,000, or $2\frac{1}{2}$ people per square mile.

Aggregating the two areas, we have a wheat belt of over 260,000,000 acres. Of this we might ultimately expect at least 40,000,000 acres under crop each year; this, with an average yield of 10 bushels per acre, would give at least 400,000,000 bushels annually,

which, at the present Australian rate of consumption per head of population, and deducting the necessary quantity required for seed, would supply flour sufficient for the requirements of over 50,000,000 of people. It is not to be thought that even this is considered the limit of our possibilities as a wheat-producing country. It is a conservative estimate of the possible production from this area only, based on a low proportion of land under crop and a low average yield per acre. In the closer settlement country wheat can be grown in rotation with other crops under conditions of intensive agriculture; the acreage shown in these areas would not approach that of the wheat belt, but with a higher average yield per acre the production would be appreciable.

It is clearly evident that the factors determining the present actual limits of the wheat belt are economic and not natural ones. The limits on the coastal side of the belt are determined by questions of profit in competition with other crop and live stock industries; inland, practically in all cases by transport facilities. The most striking instance of this is in the undeveloped areas of Mallee land on either side of the Ouyen-Murrayville railway line. Again, the decided boundary in South Australia and New South Wales where the wheat belt stops at the Murray River, coincident with the limits of railway facilities. We have a long way to go in extending this, the chief present economic limit to the development of the wheat industry, before we approach the natural boundaries indicated above.

## Sheep.

In the year under consideration, the sheep population of Australia numbered some 85,194,503, and of these New South Wales claimed 37,381,874, Queensland 18,220,985, Victoria 15,773,902, Western Australia 7,183,747, South Australia 6,625,184, and the Northern Territory 8,811 head. This number represents approximately 16 per cent. of the world's sheep, emphasizing Australia's position as a leading sheep and wool producing country.

Examining the distribution of the sheep throughout the continent (Plate II.), it is seen that the belt of maximum concentration is in South-eastern Australia, and that it coincides roughly with the wheat belt, the main departure being in the famous sheep country of the Western District of Victoria. The sheep-carrying country, however, extends much further inland and northwards than does the wheat belt. The area of maximum concentration commences in New South Wales, somewhat above the 65 deg. F. isotherm, and runs south-west through that State and Victoria on either side of the 20-inch line of annual rainfall. Such conditions of rainfall and temperature below 65 deg. F. are, given suitable soil, evidently the optimum conditions for sheep in Australia. From this region of maximum concentration there is a wide belt of decreasing sheep concentration extending inland beyond Oodnadatta and including the South Australian sheep country. The most noticeable breaks in this passage from the maximum to the minimum concentration are: (1) the low concentration areas of the Victorian and South Australian Mallee, where grazing to any extent is only possible after the land has been cleared and cultivated, and (2) the area of higher concentration where the rainfall isohyets run northwards of the Mount Lofty Ranges.

It is worthy of note that along the moister eastern side of the continent there are no appreciable numbers of sheep close to the coast line; not, in fact, until the belt of maximum cattle concentration is passed. The distribution of sheep is apparently limited here by the high rainfall, practically no sheep being found beyond the 40-inch line of rainfall. The liability to such troubles as foot-rot, liver-fluke, and other parasitic diseases is evidently one of the factors making the keeping of sheep in such districts less profitable than cattle raising.

Appreciable numbers of sheep are found as far north as Cloncurry and beyond in Queensland, and around Derby in Western Australia, both being about latitude 18 deg. S.; while, however, in Queensland the sheep do not extend appreciably beyond the 75 deg. F. isotherm, in Western Australia, the isotherms dipping south, they appear considerably above the 80 deg. F. isotherm. The temperature range of sheep is therefore considerable, as in the south-eastern corner of the continent they are found in country having a mean annual temperature below 55 deg. F.

In Queensland the greatest concentration of sheep is about Longreach, where, it is to be noted, there is a relatively sparse distribution of cattle. Over the rest of the State, inside the high rainfall coastal belt and south of the 75 deg. F. isotherm, the distribution is fairly uniform and comparatively dense. Western Australia has a small percentage of her total area as sheep-carrying country, and no region where the distribution can claim to be dense. The sheep belt is along the coast; here, however, except in the extreme south-western corner, a coastal region of low rainfall.

In considering the possible extension of the sheep-carrying areas, it may be noted that the extension during the last twenty years has not been very rapid, the numbers of sheep in Australia in 1900 and 1918 being respectively 70,602,995 and 85,194,503, or an increase of 20 per cent. as compared with an increase of 33 per cent. in human population. There is no reason why the numbers should not be considerably increased, both by the better management of present pasture lands and the opening up of new country.

The areas suggesting themselves as potential sheep country are (1) the Victorian and South Australian Mallee lands, where the stocking of the country does not, as is usual, precede, but follows on after the clearing and cultivation of the land. At present few of the Mallee settlers keep sheep, but with the passing of the pioneering stages of settlement the number of small flocks kept is gradually increasing. Better transport facilities, more than anything else, would greatly aid the development of this section. (2) There is a considerable stretch of country along the southern coast of Western Australia, bounded roughly by Southern Cross, Albany, and Eucla, which is practically devoid of sheep population. This is all within the 10-inch line of rainfall, and from climatic considerations above, it should have a carrying capacity at least equal to the South Australian west coast and other 10-15-inch rainfall areas. Indeed, compared with South Australia, where there is the greatest development of the arid country, we might look for an extension still further inland than the area indicated. Even allowing for a considerable proportion of inferior soil, there seems every reason to believe that this area is capable of supporting a population of sheep, certainly sparse, but aggregating many thousands of

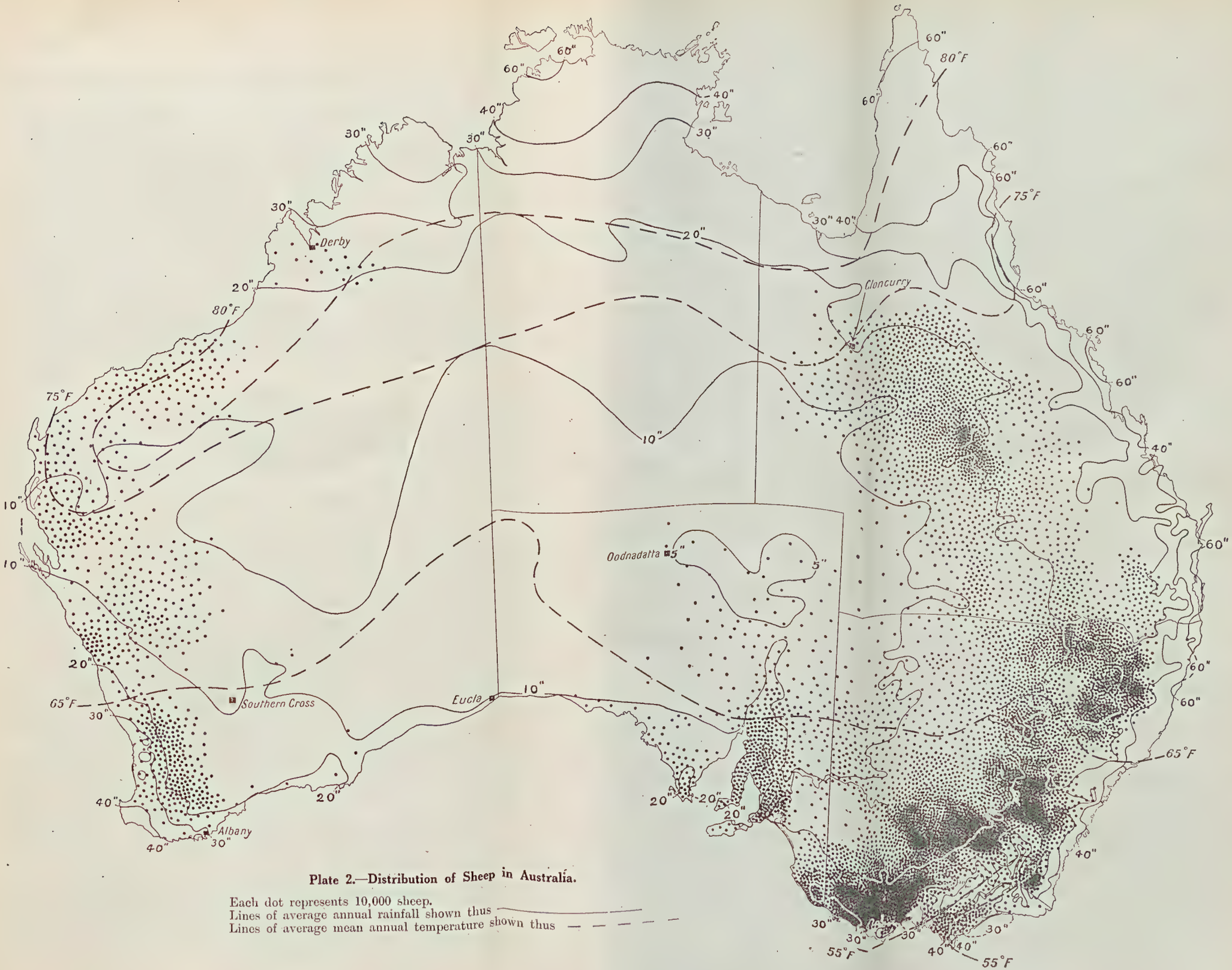



**Plate 2.—Distribution of Sheep in Australia.**

Each dot represents 10,000 sheep.
Lines of average annual rainfall shown thus ———
Lines of average mean annual temperature shown thus — — — —

head. (3) In Queensland, the limits of the present distribution show a fairly sharp line both along the northern and western boundaries. Allowing that the high temperature and heavy rainfall combine to make a northern extension of the sheep belt unlikely, there remains between the Queensland western boundary of the present distribution and the sheep-carrying areas of the north-west coast an immense tract of country still to be exploited. The number of sheep in Queensland between the 10 and 20-inch lines of rainfall, and close to the 75 deg. F. isotherm, is seen to be comparatively dense, and it can be fairly assumed that such conditions of rainfall and temperature are quite favorable to the sheep industry. Between these lines of rainfall and approximating to the same temperature is a vast tract of country stretching across the Northern Territory and Western Australia. Large areas of this land are doubtless of a more or less barren nature, but it seems likely that with increased population and improved communication and transport facilities, this area will contribute appreciably to Australia's sheep products.

## Cattle.

There was in 1918-19 a total of 12,576,842 cattle in Australia, of which number Queensland possessed 5,786,744, New South Wales 3,280,676, Victoria 1,601,544, Western Australia 943,847, the Northern Territory 621,163, and South Australia 342,768. These figures show an increase of approximately 46 per cent. on the total of 8,640,225 for the year 1900, being a much more rapid increase than that shown by sheep over the same period.

Examining the map of cattle distribution (Plate III.), the most noticeable feature is the very general nature of such distribution, cattle being found under very diverse conditions of rainfall and temperature, right from Darwin and Cape York Peninsula to the southern coast. The rainfall range is from 5 inches in the arid interior to over 60 inches on coastal Queensland and New South Wales, and the temperature range from over 85 deg. F. in the far north-west to below 55 deg F. in the south-eastern corner. The ability of cattle to withstand both cold and heat, and their great travelling capacity, making them invaluable in the pioneering stages of a country's development, are here emphasized. Compared with the distribution of sheep, they not only show this wider range, proving their greater adaptability to varying conditions, but also the regions of maximum concentration differ markedly from those of sheep. The areas of maximum concentration are found along the coasts of New South Wales and Queensland, commencing just outside the sheep country and in districts having a rainfall of 40 inches and over. Under such conditions cattle-raising and dairying, as compared with sheep, are evidently so much more profitable as to practically totally exclude the latter. The next greatest concentration is found in Gippsland and the Western District of Victoria, with temperate climate and rainfall of 30 inches and upwards, but in these areas sheep also are found.

The influence of the big capital cities in increasing the cattle population (for dairying and fattening purposes) is clearly shown in the comparatively poor country north of Melbourne, and to a lesser extent around Sydney and Brisbane. The irrigation of the drier areas has a

like effect, as shown by the relatively dense population of cattle in the County of Gunbower, Victoria, where the annual rainfall is under 15 inches. The effect of varying soil fertility and topography is strikingly shown in Queensland, where between Dalby and Gayndah, within a relatively short distance and under much the same conditions of temperature and rainfall (about the 20-inch line), we pass through a region of maximum concentration to one of very sparse distribution, and again through a maximum concentration area.

What may be called the inverse distribution of sheep and cattle holds throughout, for it will be seen that in Central Queensland and New South Wales, and in Western Australia, where cattle are relatively sparsely distributed, sheep are relatively dense, and *vice versâ*.

As regards the possible extension of the present boundaries of cattle distribution, it is seen that the eastern half of the continent is practically totally inhabited, and development is here limited to the closer population of already inhabited areas. In the western portion, however, there are vast unoccupied areas, a large proportion of which show promise of carrying, in the future, a considerable number of cattle. Climatically, there seems no reason why the cattle population of Queensland inside the 20-inch line of rainfall should not extend across the similar belt through the Northern Territory and Western Australia. The regularity of the rainfall over most of this area is quite as great as in some of the well-populated country of Queensland with a similar annual total. Artesian and sub-artesian water has helped greatly in the latter region, and there seems every prospect of this being obtainable over much of the country indicated. Then there is the south-western portion of the continent having a rainfall of over 10 inches, and here of great regularity, to be regarded as the potential carrier of a sparse cattle population, with the possibility of a concentration in the extreme south-west corner where the rainfall is over 30 inches. Here there are now, relative to the rainfall, very few cattle, the country in its natural state being unsuited to grazing; but with the progress of agriculture there is every reason to expect a rapid increase in the numbers of cattle maintained in this well-watered region.

A word as to the agricultural potentialities of Australia as indicated by this cattle distribution map. It is an axiom among stockmen that "cattle country is good country"; and when we consider not only the great concentration along the fertile coastal belt of the continent, but also the vast areas of New South Wales, north-west Australia, and particularly Queensland, carrying, relative to their human population and stage of development, a dense and uniform stock population (for it must be remembered that sheep largely fill up what appear to be the blanks in the cattle map), we can see room for a tremendous increase in the number of Australia's people, her stock and agricultural industries, before there is need to seriously consider how we are to support her excess population in that arid interior of which we are frequently reminded. Even in this arid interior we find, along the only long established line of communication, viz: the Oodnadatta railway line and telegraph line to Darwin, some cattle; and it seems evident that, as our knowledge of the country and facilities for communication and transport improve, much of this land will carry stock in numbers quite sufficient to repudiate the name of desert.

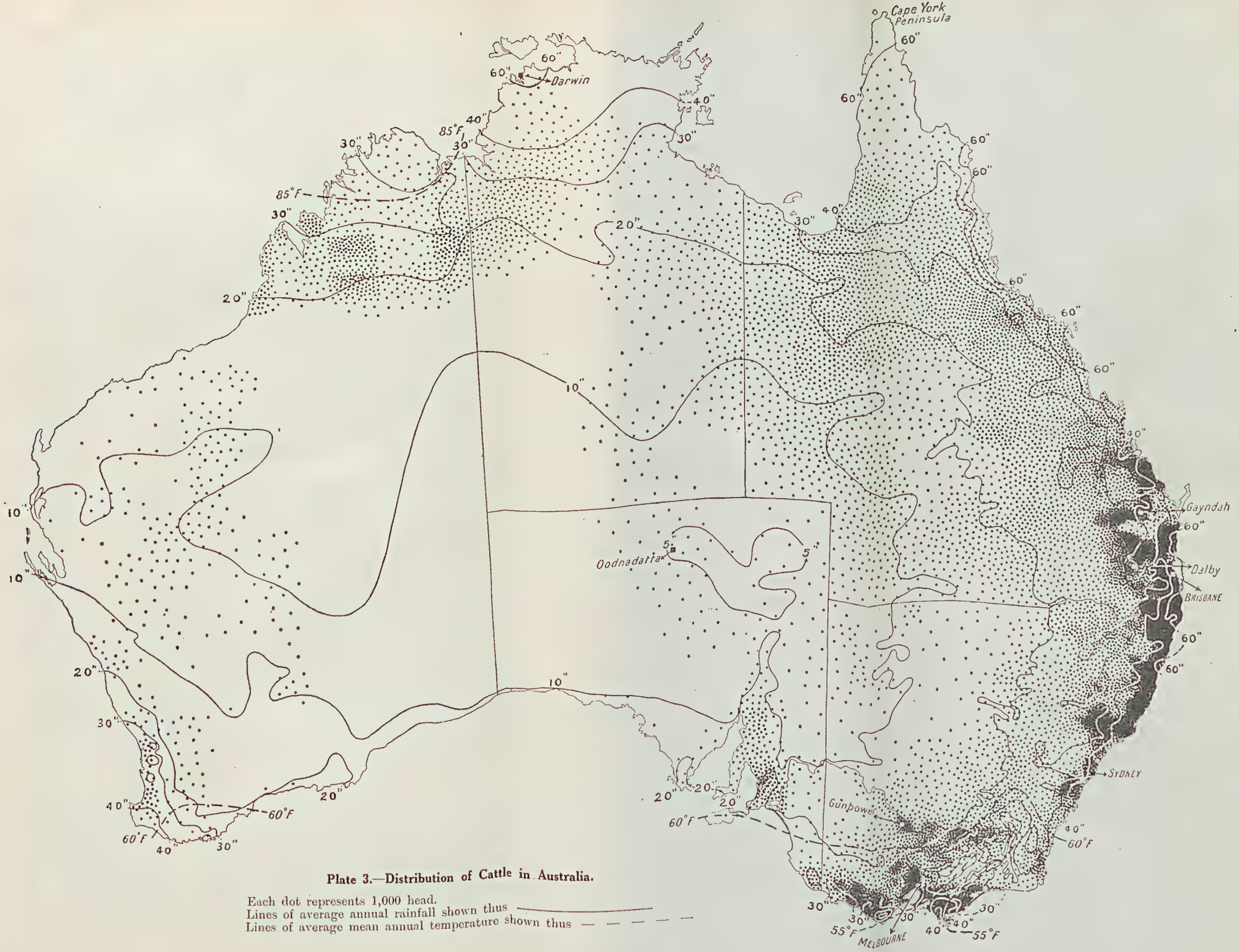



**Plate 3.—Distribution of Cattle in Australia.**

Each dot represents 1,000 head.
Lines of average annual rainfall shown thus ———
Lines of average mean annual temperature shown thus — — — — —

# THE SNOWY RIVER FLATS AT ORBOST.

*By L. C. Bartels, B.Ag.Sc., Science Field Officer.*

## Maize Growing.

Victoria has many areas of rich agricultural land, but none more renowned for fertility than that area of 35,000 acres around Orbost, in East Gippsland, known as the Snowy River flats.

Orbost is situated in picturesque country, and is 10 miles from the mouth of the Snowy River. The hills bordering the valley are heavily timbered, and there is profuse growth of vegetation everywhere.

The river in its course traverses the volcanic areas of the Monaro plateau, and lower down passes through Buchan limestone country. From these sources, as well as others, the soil on the flats has been built up. Most of the land is subject to floods, and there is evidence of the amount of silt carried by the river in the extensive depositions recently made. Huge tree trunks are found buried at considerable depths, and boring operations carried out in one place to a depth of over 100 feet showed that the deposits are uniform to that depth. It is asserted that in places, as at Bete Bolong South, from 6 to 10 feet of silt has been laid down within the last forty years. The newer deposits are not at once as fertile as those of earlier origin.

On the Orbost flats, there are two main types of soil—sandy loam and clay loam. When the flood waters spread across the flats, the heaviest particles in suspension settle first, and on the river frontage the soil is a sandy loam, while the finer material is laid down further from the river banks. In the morass country, which extends to the hills, the soil has been built up by sedimentation, and accumulation of organic material. Some peaty land exists. This morass or river swamp country is the more extensive, the proportion to the frontage land being about 3 to 2. Both are good soils, but in its natural state the morass land looks uninviting. When it is grazed, the trampling of stock produces small hummocks with coarse vegetation. By drainage and cultivation it is transformed into wonderfully fertile land. The hummocks, which are really big tussocks, are ploughed out and broken up, and afterwards the land is fairly easily cultivated. Considerable improvement is effected if the floods carry silt on to morass land.

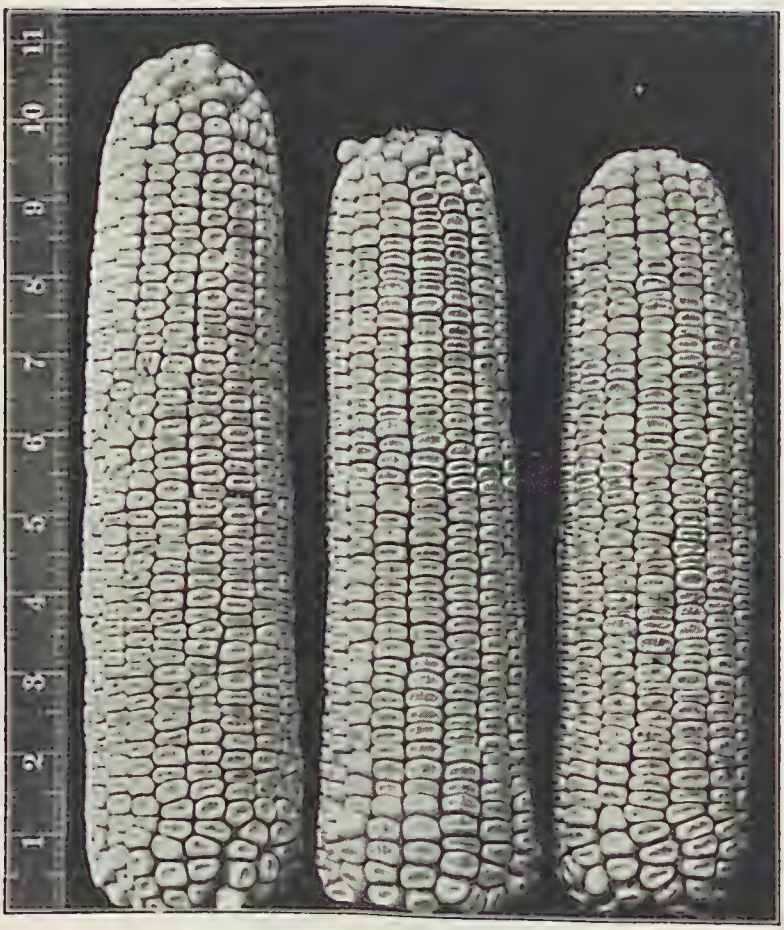
At Orbost, maize-growing is the most important industry, and 600,000 bushels is the average annual production. Authentic yields up to 125 bushels per acre have been obtained, and it is claimed that yields of 145 bushels per acre have been reached. A fair amount of dairying is carried on. Pig-breeding has always been an important industry, and beans are grown by most farmers.

Much of the land is continuously cropped, and some fields have been growing maize for thirty or forty years.

The cultural methods adopted in maize-growing are fairly uniform, although they have to be modified slightly on some types of soil. When picking is finished, cattle are turned into the maize fields to graze. The stalks left standing are then knocked down. Most farmers rake and burn them, but some growers chop them up and turn them in with a disc plough. In some cases, an implement with straight-fixed discs, set about 7 inches apart, is used to chop up the stalks before ploughing.

Some farmers assert that the ploughing-in leaves the ground too open; certainly, it renders subsequent operations more difficult. Ploughing is followed by disc cultivation, disc harrowing, rolling, or levelling.

Sowing commences in October. All maize is machine-planted, and, on the average, 14 lbs. of seed per acre is sown. The field is harrowed soon after planting till the young plants appear. This particular operation is of great importance in suppressing weeds. Horse-hoeing follows, and this is carried on till the maize is from 3 to 4 feet



**Cornplanter Maize, grown at Orbost, 1922.**

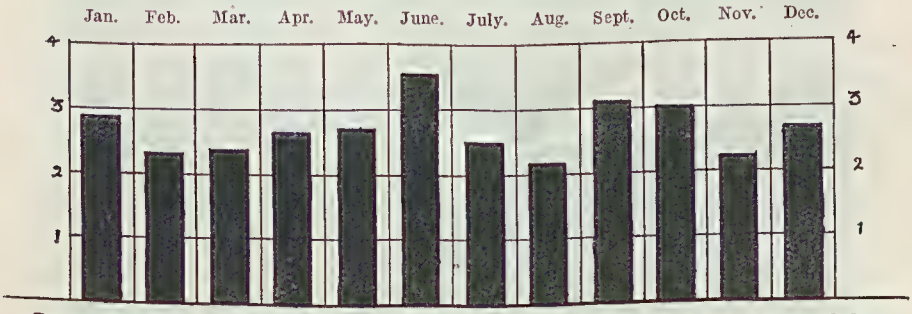
high. More attention is being given to this work, with a view to minimizing the amount of hand-hoeing necessary later on. It is found that some weeds may be smothered when young, and advantage of this is taken in the practice of moulding between rows. It has been shown that one man can keep 50 acres of maize in good order.

Weeds grow strongly. Prince of Wales' Feather (*Amaranthus*) is considered the worst; Thornapple (*Datura Stramonium*) is a bad weed; Fathen (*Chenopodium glaucum*), and Cockshin (*Panicum Crus*

*galli*) are abundant, while *Galinsoga parvi flora,* locally known as Peterson's pest, is becoming common.

In April, maize begins to die off, and picking commences. It may be understood that, in a district such as Orbost, where extensive areas of maize are grown in proximity, the different varieties are not well defined. Through the enterprise of Mr. H. James, and others, several kinds have been introduced as the result of selection, or by importation from America. It cannot be said that close attention is paid by growers to the selection of seed. The practice everywhere is to select from the crib, and farmers generally strive for high yield, without particular regard to type. By continued selection, different men have evolved fairly uniform types, but opinions differ slightly as to what constitutes the true type of any particular variety. Weight of cob, with deep grain and accompanying small core, is sought.

Sibley is the variety commonly grown. It is a mid-seasonal yellow Dent maize. Funk's Yellow Dent, Brewer's Dent, and Early Yellow Dent are also grown. Cornplanter, a white Dent maize, is being grown in increasing quantities, and it is considered to be a better variety for frontage land. Hickory King is grown mainly for seed; it commands




**Graph showing the average distribution of the rainfall throughout the year at Orbost over a period of 32 years. Average, 31·89 inches per year.**

a higher price than other maize. There is practically no flint maize grown, although Long Tom and Ninety Day, both flint varieties, were the first introduced.

Leaming and Ried's Yellow Dent were originally the two main varieties in the United States. The development of these was carried on in families. Their characteristics are continually manifesting themselves in the newer varieties.

James' Eclipse was Leaming, selected, and made uniform.

Sibley has been developed from Ried's Yellow Dent; Funk's Yellow Dent and Brewer's Dent were bred from Ried's Yellow Dent by Funk Bros. and Brewer, respectively.

Cornplanter was developed by Mr. H. Field, of Shenandoah (Pennsylvania). Twelve cobs were exhibited in a competition for which the prize was a cornplanter. These twelve cobs were awarded the prize, and were purchased by Mr. Field, who evolved the variety from them.

The heavy yields of maize obtained at Orbost indicate that almost ideal conditions exist there. Some of the factors which contribute to this are the depth and texture of the soils, with their high capacity for retaining moisture—there is an annual rainfall of nearly 32 inches

regularly distributed throughout the year. The atmosphere is humid, and in summer heavy dews occur.

### Bean-Growing.

Bean-growing is an important industry at Orbost. Most farmers grow beans as a side-line. The main purpose is the production of seed, which is supplied to the Melbourne seed merchants, and by them delivered all over Australia.

French Canadian Wonder beans are mostly grown, but other varieties referred to as fancy beans are grown extensively. The conditions are favorable for the production of the highest grade of seed, and the superior quality attained has set a very high standard. Canadian Wonder is a difficult bean to grow. Seedsmen desire a dark bean, although it must be stated that it does not give a better germination, or even a superior crop. Other beans are not so difficult to produce, and a second-rate soil gives a good quality. Other parts of Gippsland offer good conditions for most varieties, but not always for Canadian Wonder beans. The industry may be developed, but the local demand can be quickly overtaken. It is possible that an export trade could be developed.

The yield from a good average crop is up to 40 bushels per acre. The price fluctuates with the supply. The weather may spoil the crop in a district. At present, they are worth 25s. per bushel, but they have brought £4. Some growers sell the green pods, and put in 3 or 4 acres for the purpose.

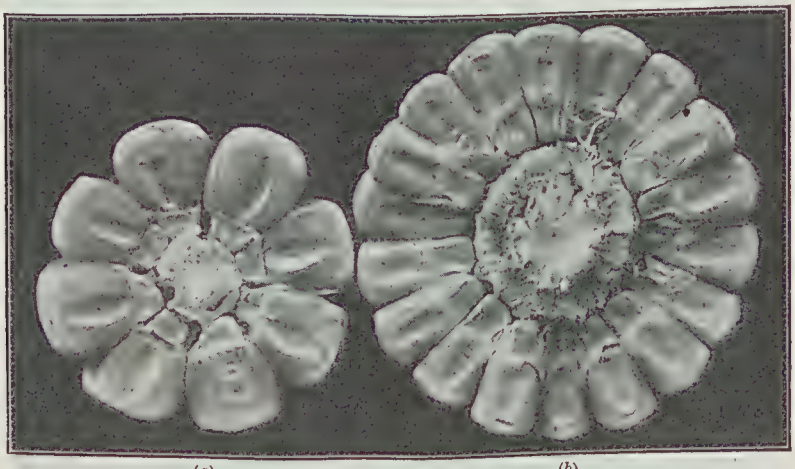
It is desirable that the beans should be harvested in February or March, and the endeavour is made to have them sown in the beginning of October. The seed bed must be fine. The beans are planted with a maize planter in rows 2 feet to 2 ft. 4 in. apart. One and a quarter bushels of seed per acre is sown, which is allowing one bean for every 3 or 4 inches. The surface of the soil may crust, and the seed leaves of the young bean may break off. To guard against this, shallow sowing is the rule, and a light onion harrowing is given when the seed has germinated. Horse-hoeing and hand-hoeing are practised. When the plant is at the flowering stage, "rogueing" is carried out. The bush beans and runner beans may be distinguished then, but other variations must be watched for at podding time.

When the plants begin to die off, they are pulled instead of being left till they are dead ripe. The ripening is finished after pulling. The beans are very susceptible to damp, and will easily become mildewed.

In warm weather, the beans shed from the pods very easily, and so they are nearly all hand-pulled. They are left in the field with the roots uppermost, and after a week they are carted for thrashing. If conditions are favorable, they are thrashed in the field, and the method of thrashing is to spread them on a sheet, where a roller is driven over them. After this, the beans are bagged, and a lot of dust and leaves, &c., is left with the seed to absorb excess moisture, and here they complete the ripening, and even darken in colour. After thrashing, they are winnowed, and are then picked over so that split seed and flat and discoloured beans may be removed. Five or six shillings a bag is paid for this operation.

Mr. James has an up-to-date bean-cleaning plant, which does the work efficiently at a reduced cost. The beans are first winnowed by a machine, in which the speed of the fan can be easily altered. In a subsequent operation, they are mixed with damp and then dry sawdust. This polishes dirty and mildewed beans. Another ingenious machine locally devised is called the Separator or Gravitation Table. This consists of a moving sheet, the surface of which slopes in the direction at right angles to the direction of movement. The beans pass on to this table, and split beans and flat beans are carried over the end, while the rounder and heavier ones slide off. Hand-picking is the final operation.

Fourteen or fifteen varieties of beans are grown at Orbost, including dwarf and runner green beans, and wax-pod or butter beans. The main variety grown is Canadian Wonder, and, as previously stated, seed production is the chief object.



(*a*) (*b*)
**Cross-section of Ears. (a) Hickory King. (b) Cornplanter.**

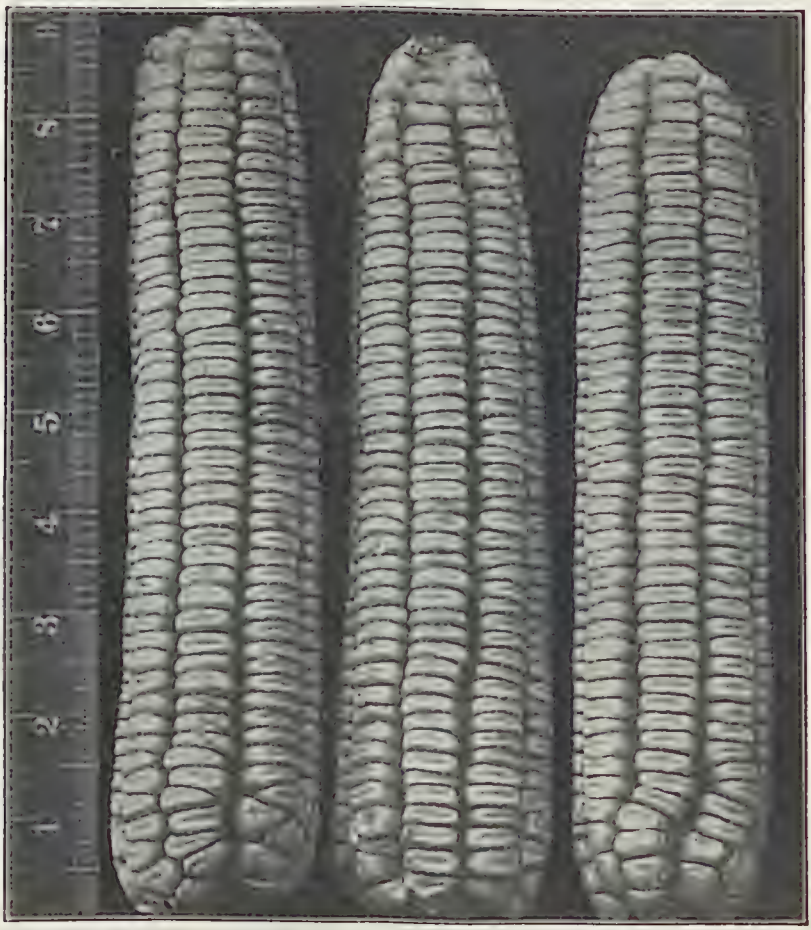
## Maize-Growing on Lindenow Flats.

In the valley of the Mitchell River there are about 10,000 acres of river flats, of which about 6,000 acres are devoted to maize-growing. The Lindenow flats, near Bairnsdale, rank next to Orbost as a maize-growing district. The flats are not as productive as those along the Snowy River. These latter are of more recent origin, and the repeated siltation maintains their fertility. At Lindenow, there is a depth of from 10 to 12 feet of soil overlying coarse gravel. The rainfall, 28 inches per annum, is lower than at Orbost; but if rain comes at a favorable time, very high yields of maize are obtained—60 to 70 bushels is the average. In exceptional cases, over 100 bushels have been obtained.

The soil on the flats varies from fine sand or silt to clay loam. The silt, which is of excellent quality, borders the river, and further away is the black, heavier soil. In this latter area are depressions or "gullies," where the soil is very fine. The soil in these gullies is most productive. In addition, there are patches of soil with a slight chocolate tint—these are relatively "poor" areas.

The success of maize-growing at Lindenow depends on effective conservation of moisture. This is achieved by early and deep ploughing, with repeated cultivation.

The stalks of the old crop are broken down with harrows, raked together with a tumbling rake, and burned. (It is considered that repeated ploughing-in is associated with the occurrence of fungus diseases and caterpillars). Those that remain are chopped up with the cutter designed for the purpose. Incidentally, this gives a light cultivation, and prevents the formation of clods. The land is then



**Ears of Hickory King Maize.**

ploughed to a depth of from 6 to 9 inches. If the disc plough is used, it ploughs up the land without altogether inverting the soil. The packer roller follows, then the disc or spring-tooth cultivator, and harrows.

At Lindenow, particular care is given to the preparation of the seed bed; this facilitates cultivation when the crop is up. In places, superphosphate is applied at the rate of from 80 lbs. to 112 lbs. per acre. Commonly, three grains are set in a hill, but some growers would prefer

two. Sowing is done in October. The first harrowing is given from five to twelve days after sowing. This is the most important operation; harrowing may be continued at intervals till the maize is 7 inches high. The farmer does not wait for weeds to appear, but repeatedly cultivates the land, and endeavours to smother weeds by "moulding" the soil between the rows. Discretion must be used if roots are being damaegd, particularly in a dry season.

Sibley is the maize commonly grown at Lindenow. Different varieties have been introduced from time to time, and inter-breeding has produced various types. Some white maize is grown, but the area given to it is decreasing. There is probably little difference in yield between it and red maize, and no particular objection to white maize is offered.

Seed is selected from the crib, and the farmer looks for deep grain on a well-filled cob. Roughness of dent is associated with depth of grain, but also usually with thinness. Thickness of grain is desirable, but this characteristic is often linked with shallowness of grain, and continued selection of thick grain would reduce the yields; but, by retaining for seed some cobs with long thin grain, crossing maintains an intermediate condition.

At and around Lindenow is undulating country, with sandy soil on the hills and clay land at the foot. This land is typical of thousands of acres in Gippsland. Heavy timber grows on these areas. Stringybark and sheoak on the hills, and redgum on the stiff soils. These stiff soils, when cleared, grow winter fodder, and will also grow good wheat; but rust is prevalent. The light soils on the hills are covered with bracken. When cleared they are very productive. They vary from rather poor gravelly soil on some of the hill-crests to nice sandy loam. They bear fair maize crops.

Prime maize-growing land in Gippsland is limited, and it is on these hills that extensions will be made. Notable examples are presented by men who have cleared this land and are attaining yields of from 35 to 50 bushels of maize; and instances are quoted where 70 bushels per acre have been obtained.

## Conclusion.

Orbost and Lindenow have long been famed for maize-growing. Bean-growing at Orbost is assuming more importance of late years. As might be expected, the maize yields at Orbost range amongst the highest attained anywhere in the world.

Over 80 per cent. of the maize produced in Victoria is grown in East Gippsland, and in the season 1920-21, the amount produced in the State was 1,066,000 bushels, with an average yield of 44 bushels per acre. This is low, and shows a decline on the average production of earlier years.

At both Orbost and Lindenow, the cultural processes adopted are of a fairly high order; although, in both places, there are farmers whose methods surpass those of their neighbours.

Besides being used for fodder, maize yields a number of products, including cornflour, glucose, and oil, and the by-products obtained in the manufacture of these are useful stock feeds. Maize-growing is capable of expansion and of improvement; but Orbost and Lindenow, and the other river flats, with their great natural advantages, will always be the main centres of the industry in Victoria.

# CROP AND FALLOW COMPETITION, HORSHAM, 1921.

**Report of the Judge, H. A. Mullett, B.Ag.Sc., Chief Field Officer.**

This year there were seventeen entries for the Crop and Fallow Competition conducted by the Horsham Agricultural and Pastoral Society. This may seem a small entry for a progressive district like Horsham in a season like the past, where 40-bushel crops were fairly common; but it must be remembered that this year the Society also instituted another type of competition, for which more substantial trophies were given. Prizes valued at £60 were offered for the best bag of commercial wheat as received from the harvester, the object being to improve the commercial sample of the district. This competition attracted a very large entry, so that it cannot be said that any lack of interest is shown in educational movements among farmers at Horsham.

The average rainfall received last year was 19.4 inches, of which 11.6 inches fell in the growing period of the wheat crop, which at Horsham is June to November.

The crops were regularly prolific throughout the district. They were exceptionally free from diseases such as flag, smut, and take-all, though a little red rust was present. A number of them were on the rank side—in a few cases they were down in patches. Some very high yields were recorded. In one authenticated case an average of 50 bushels per acre was secured by Messrs. Hobbs and Knuckey over 160 acres. Some 250 acres of Federation at the Longerenong College averaged 45 bushels per acre, and the whole area sown (380 acres) yielded at the rate of 42 bushels per acre; nor were these the only cases.

But where the proper methods are adopted there is nothing exceptional about these results at Horsham on this soil, for yields of that order have often been secured by the best men during some years past. Compared, however, with the crops grown 20 years ago, there is a wonderful improvement. Then a 20-bushel crop was a good one. The intervening period has witnessed many changes. First there came superphosphate, then fallowing, then Federation wheat, then thorough cultivation, heavier seeding, and finally late sowing. All of these innovations have been contributory factors in raising yields to their present high level. But the average farmer at Horsham cannot claim to have reached the highest limit possible. When he raises his rate of seeding to 80 or 90 lbs. per acre for late sowing, and the amount of manure to from 1 cwt. to 1½ cwt., when he introduces summer fallow and systematically works it, when he cultivates the fallow to till it as well as to kill weeds, and when he pays more attention to systematic crop rotation, then heavy yields will become general.

The soil at Horsham is both rich and deep; it is the kind of soil that it pays to farm well.

## Results.

### Section I.—Crop and Fallow Competition.

For the highest aggregate award for 100 acres of fallow 1920, and for the crop grown on the same fallow 1921.

Messrs. Miller Bros. secured the highest aggregate, 190 points, over the two years, 97 points being gained for the fallow in 1920 and 93 points for the crop 1921. G. W. Hobbs was second with 91 points for fallow and 94 for the crop, totalling 185 points.

Other good crops were exhibited by Messrs. Worth Bros. and Messrs. Smith Bros. (Glenburnie). One paddock of 40 acres entered by Messrs. Smith Bros. (Waverley) was also very heavy. The crop shown by Mr. H. Klous, grown on heavy crab-holey country near the Wimmera River, had gone down badly.

**Heavy Crop of Federation (Messrs. Miller Bros., Horsham).**

Messrs. Miller Bros.' crop was uniformly good. The yield was heavy, the seed reasonably true to type, there was a complete absence of weeds, and no disease was noticed. While lacking somewhat in density, nevertheless there was no excess straw and the heads were well filled. These two latter characteristics are usually indicative of good yields. The method adopted in raising this crop was as follows:—The paddock was winter fallowed in July to about 3 inches deep; then it was harrowed twice. In September the scarifier was used to kill weeds, and then two strokes of the harrows were given. Sheep were allowed access to the fallow, which was not again cultivated until the following autumn. The paddock was scarified in April and re-scarified in front of the drill late in June. At the end of June it was seeded with 80 lbs. of Federation wheat obtained from the Longerenong College, and 90 lbs. of super. per acre applied. Weeds appeared later, and two light strokes of the harrows were given. The weeds were killed, but apparently some of the wheat was thinned out. It will be noticed that no less than ten cultural operations were given this field in preparation for the crop.

Mr. Hobbs' crop was the heaviest seen in the competition. Some mustard seed was present, for which points were deducted. This was an exceptionally short crop. It was drilled during the second week in July and was "sheeped" during part of August. Mr. Hobbs believes in thorough ploughing and scarifying. The fallow was ploughed in July to 4 inches deep, then it was harrowed twice. In September, early, a scarifying was given, and another in October. In January and again in March the harrows were kept going to fill cracks. In May the fallow was scarified up and then the weeds allowed to germinate. The scarifying was repeated in July and the paddock was drilled a week later; 60 lbs. of seed were used, with 90 lbs. superphosphate. Mr. Hobbs follows the method successfully practised at Longerenong College of scarifying the fallow twice in the spring and twice before seeding in the autumn. Ten workings in all were given. Federation was the variety grown.

**A Fifty-bushel crop grown by Messrs. Hobbs and Knuckey, Horsham, 1921.**

Messrs. Worth Bros.' crop was the new variety raised by Mr. A. Huff, and known as Huff's Imperial. It is a short strawed, very compact, red variety obtained as a selection from Federation. The fallow was winter fallow, ploughed to 3 inches and carefully worked. Seven separate strokes with the harrows were given, but only two scarifyings; 90 lbs. of seed per acre and 100 lbs. of superphosphate were applied.

The crop of Federation shown by Messrs. Smith Bros. (Glenburnie) was one of the heaviest seen. It is the product of a special system which they practise with success. The plough and scarifier are wholly relied upon and the harrows dispensed with, their place being taken by sheep, which are, of course, singularly effective in breaking down Wimmera fallows if left rough. Messrs. Smith Bros. consider the tramping of the sheep especially beneficial in securing the required consolidation on these friable soils. They crowd sheep on to their fallows for the express purpose of tramping it. The following is the treatment given the

crop. Early in August the paddock was ploughed to about 3 inches deep. In September and again in October the scarifier was used to give a thorough cultivation. Sheep were then allowed access. In April the scarifier was used, and again in June. The paddock was seeded late in June with 60 lbs. wheat and 80 lbs. superphosphate. It may be noted, however, that Messrs. Smith Bros.' land is not typical of the Wimmera plains as a whole. It is exceptionally deep and rich.

Details—Section I.—Crop and Fallow Competition.

Prize for highest aggregate award for 100 acres of Fallow 1920, and for the crop grown on the Fallow 1921.

| Name. | Yield. | Trueness to Type. | Disease. | Weeds. | Evenness. | Total for Crop, 1921. | Total for Fallow, 1920. | Grand Total. |
|---|---|---|---|---|---|---|---|---|
| **Possible points ..** | **35** | **20** | **15** | **15** | **15** | **100** | **100** | **200** |
| Miller Bros. .. | 31 | 19 | 15 | 14 | 14 | 93 | 97 | 190 |
| G. W. Hobbs .. | 35 | 18 | 15 | 11 | 15 | 94 | 91 | 185 |
| Worth Bros. .. | 32 | 16 | 10 | 12 | 15 | 85 | 94 | 179 |
| C. Reinheimer .. | 31 | 19 | 10 | 11 | 15 | 86 | 91 | 177 |
| Smith Bros. (Waverley) | 31 | 19 | 15 | 13 | 13 | 91 | 87 | 178 |
| Smith Bros. (Glenburnie) | 33 | 17 | 11 | 13 | 14 | 88 | 88 | 176 |
| H. Klous .. | 29 | 19 | 14 | 14 | 8 | 84 | 87 | 171 |
| A. G. Turnbull .. | 24 | 17 | 14 | 12 | 10 | 77 | 73 | 150 |

Section 2—Crop and Fallow Competition—Fallows, 1921.

The crops grown the coming season on the various fallows shown should afford interesting comparisons. Of the nine entries submitted, five were summer-fallowed and four were winter-fallowed. Some paddocks had had as many as eight separate strokes with cultivation implements, while others had been given only four. Two of the fallows had been prepared without the use of the plough at all.

Messrs. Murray Bros.' paddock of summer fallow was placed first. This paddock was in excellent condition. The mulch was deep, mellow, and in particular the bottom of the seed bed was level and firmly consolidated. A point or two was deducted for the presence of weeds. This paddock had been thoroughly ploughed in the first instance in March to 4½ inches deep. In July it was scarified, in August harrowed, and then re-scarified. In October and also in December it was harrowed.

Messrs. Worth Bros.' fallow, awarded second place, received seven workings, but it was not at any time ploughed. In March it was scarified, which operation was repeated in July. Then two strokes of the harrows were given. In September another scarifying took place, followed by harrows. In November the paddock was re-scarified and then harrowed. The result was an excellent fallow.

Messrs. Miller Bros.' fallow was winter-fallowed in July; if anything, the mulch was on the shallow side. Spear thistles made their appearance in great numbers in December, but were effectually dealt with when small with the aid of a "knife" attached to the scarifier.

Messrs. Lehmann Bros. also used the "knife" to cut weeds on the fallow. An illustration of this type of implement accompanied the report of the Nhill Farm Competition printed in this *Journal* for March last. The knife has the advantage of cutting every weed and at the same time not stirring the soil too deeply.

Judging by the fallow seen, there is considerable local divergence in the methods used for creating and maintaining the fallows at Horsham. It is probable that one of these methods is superior. The land is heavier than most in the Wimmera, and it is obvious that methods standardized there do not necessarily apply here.

DETAILS—SECTION 2.—CROP AND FALLOW COMPETITION.

Fallow ploughed 1921. Crop on the Fallow judged 1922. Prize for the highest aggregate over the two years.

| Name. | Moisture. | Mulch. | Weeds. | Cultivation. | Total. |
|---|---|---|---|---|---|
| **Maximum points** .. .. | **25** | **25** | **25** | **25** | **100** |
| Murray Bros. .. .. | 25 | 25 | 23 | 25 | 98 |
| Worth Bros. No. 1 .. | 24 | 24 | 24 | 25 | 97 |
| Miller Bros. .. .. | 24 | 23 | 23 | 25 | 95 |
| Smith Bros. .. .. | 25 | 22 | 25 | 22 | 94 |
| C. Reinheimer .. .. | 23 | 22 | 25 | 24 | 94 |
| G. W. Hobbs .. .. | 22 | 22 | 25 | 24 | 93 |
| E. H. Rudolph .. .. | 24 | 23 | 25 | 20 | 92 |
| Worth Bros. No. 2 .. | 22 | 23 | 21 | 23 | 89 |
| Lehmann Bros. .. .. | 22 | 22 | 23 | 20 | 87 |

## Farming Systems at Horsham.

In my report of last year the system of farming in the district was dealt with at length. It was stated that the popular tendency in the district was to crop the land very closely to wheat after fallow without a rest or change of crop unless this was forced by an outbreak of take-all. It was pointed out that there was no doubt that the practice was the most immediately profitable, but that it is doubtful whether in the long run it could be continued without increased attacks from disease and lessened yields through humus exhaustion. The present system was certainly justified when pioneering, or as a war measure when the maximum supplies of foodstuffs were required and when prices were high, but it cannot be accepted as the best possible permanent system of agriculture. Where oats are introduced, and particularly where they are specially sown for feeding-off purposes, for live stock, the drain on the soil fertility is lessened, the risk of disease is minimized, and the immediate profit is really little less.

### TENANT SYSTEM.

A pernicious tenant system is arising in the Wimmera under which owners are exacting the highest possible rents from tenant farmers. The tenant has no option but to crop the land to wheat in the closest possible way, and there is thus no incentive to maintain the land in a permanently fertile condition. Many leased farms are notorious also for the dilapidated state of the permanent improvements. Owners

demanding high rents must recognise that what they gain in rent they may lose several times over in depreciation of improvements and impoverishment of soil. All covenants between tenant and owner should provide for the maintenance of soil fertility unimpaired. That is to say, they should stipulate the rotation system to be employed.

### A 430-acre Farm at Horsham.

What Wimmera land will do when well farmed is illustrated in a very definite way by the success of Mr. G. Jenkinson, "Roseleigh," Horsham, whose farm is only 430 acres in area. A regular rotation system is practised, including fallow, wheat, and grass, and 20 to 30 acres of oats are grown each year. Usually 150 acres are sown to wheat, 150 acres are fallowed, 50 acres are in oats, and the balance of 100 acres is in grass. From 50 to 100 sheep are maintained.

**Improved Type of Stable (Messrs. Smith Bros., Horsham).**

Mr. Jenkinson sows on winter fallowed land, works it well, and sows 1¼ bushels of seed with 80 to 90 lbs. of super. He seeds about three weeks after the first rains. He has not averaged under ten bags per acre for the last ten years; his highest yield was fourteen bags to the acre. His comfortable homestead reflects the general prosperity he enjoys.

### Summer Fallow at Horsham.

So far the practice of summer fallowing has not made such headway at Horsham. None of the crops entered for competition this year was grown on summer fallowed land except portion of Mr. Reinheimer's. A number of the fallows submitted for competition, however, were summer fallowed. The experience elsewhere in the Wimmera is that summer fallowed land produces heavier crops by one or two bags to the acre, and in this connexion it is worthy of note

that the 160 acres of Federation grown by Messrs. Hobbs and Knuckey at Dooen, which averaged 50 bushels per acre, was grown on summer fallow.

### An Effective Stable.

The question of labour saving when feeding, handling, and housing working horses is a perennial one on the wheat farm. Messrs. Smith Bros., of Horsham, have designed and erected a stable which effectively reduces this work to a minimum. The principal points about this stable are that the horses are back to back, and thus can be easily handled by the teamsters, that the central passage way is wide enough to yoke a four-horse team in the stable if necessary, and that the feed can be trucked to each horse without involving carrying or lifting. The stable houses twenty-four horses, and contains two loose boxes. It is 66 feet x 40 feet. The feed alleys at the head of the horses are 4 ft. 6 in. wide, and the stalls are 6 feet deep. They are made 5 feet wide so as to preclude the possibility of the horse attempting to turn round in the stall. There are substantial doors swung on patent roller gear at each end of the stalls. They are each 13 feet wide. The object is to allow of free entry and egress of horses and of air and light. At night the horses are allowed free entry or exit to the stalls as they please.

The chaff-house holds 50 tons of chaff, enough for several months supply. It is placed on the roof of the stable on five 12 x 3 oregon rafters. It is 40 x 20 x 12 feet high. The chaff-house helps to keep the stable cool, and the chaff comes down two large chutes 10 feet square at the widest point, tapering to a nozzle when over the trucks. There is a truck at the head of each group of horses. A photograph of this stable is included.

Messrs. Pope Bros., of Donald, have also adopted the stable of the tail to tail type. Plans and specifications kindly supplied by Messrs. Pope Bros. were printed in this *Journal* for June.

## BENALLA FALLOW COMPETITION, 1921.

### Report by the Judge, H. A. Mullett, B.Ag.Sc., Chief Field Officer, Department of Agriculture.

This competition, the initial effort of the Society in this direction, is the outcome of a local feeling that there is something more to be learned about fallowing methods under the conditions that exist at Benalla. It may seem strange that a district enjoying an annual rainfall of about 26 inches should require to fallow for wheat, but leading farmers who are competent to speak state that not only is fallowing the most convenient method of preparing land for wheat there, but also that the yields obtained are substantially better than those obtained by merely ploughing and sowing. The increase due to the fallow is set

down roughly at 6 bushels per acre. In a few cases a catch crop of millet, or sometimes rape, is taken off the fallow, but the majority prefer the bare fallow.

Obviously it is wasteful to allow the land to remain bare when useful fodder can be grown, but it is yet to be determined whether there is a detrimental influence on the succeeding crop by such a practice. The results of the experiment field at Rutherglen in the North-east (21-in. rainfall) indicate that there are distinct possibilities of growing a forage crop at Benalla without detriment to the wheat, and indeed with benefit, but actual test is required under Benalla conditions.

In the meantime the immediate question for solution is to determine the best method of preparing the bare fallow. Thus, when should the land be ploughed, and how deep? Should it be worked to preserve a mulch, or should it be allowed to lie in the sod for the greater part of the time it is fallow? On this question, if there is any definite guidance, it is to be obtained from the experimental field at Rutherglen. The rainfall is lighter there, but the soils on that farm are not unlike some of those in the vicinity of Benalla. The grey buckshot soils are here referred to, not the red loams.

## Results—Cultivation Tests, Rutherglen.

This field has been permanently established since 1912. The results for a number of years are therefore available. July ploughing was found the most effective where the land was subsequently cultivated, but if no cultivation were given it made no difference whether the ploughing was left till October. The July ploughed land, well cultivated, gave 6.4 bushels per acre more than the land unfallowed and just ploughed up before seed time. These figures correspond very well with what farmers find at Benalla.

Table.—Results of Six Years' Tests, Experimental Farm, Rutherglen.

| | Average yield per acre. |
|---|---|
| Ploughed 5 inches deep at seed time, non-fallow | 12 bushels |
| Ploughed 5 inches deep, October, and not cultivated, fallow | 15.6 bushels |
| Ploughed 5 inches deep, October, and cultivated, fallow | 15.8 bushels |
| Ploughed 5 inches deep, July, and not cultivated, fallow | 15.3 bushels |
| Ploughed 5 inches deep, July, and cultivated, fallow | 18.4 bushels |

That is to say, if the ploughing is delayed until October no amount of work subsequently will make up for the late ploughing. In the case of July fallow, by cultivation, 3.1 bushels extra per acre were obtained as compared with land ploughed at the same time and left in the sod.

Now, in interpreting these results for Benalla conditions, it must be remembered that the Benalla winter is moister, and consequently it is difficult to plough the land there as early as July. But it is

probable that the earlier the land is ploughed after the winter the better, and that it pays to work it in spring and after heavy rain, provided that the soil does not work down too fine.

The Rutherglen tests furnish very definite evidence indeed on the depth at which land should be ploughed in the north-east. It is well known that shallow ploughing is favoured in the Wimmera and Mallee, but in the north-east the standard depth is about 5 inches. The Rutherglen tests fully justify this depth, and indicate that where the depth of soil permits, even greater depths give better yields.

### Results at Rutherglen over six years.

| | Average yield per acre |
|---|---|
| Ploughed 3 inches deep, July, and cultivated | 15.6 bushels |
| Ploughed 5 inches deep, July, and cultivated | 18.0 bushels |
| Ploughed 7 inches deep, July, and cultivated | 19.3 bushels |
| Ploughed 9 inches deep, July, and cultivated | 19.1 bushels |

### Working Fallows at Benalla.

If, then, we are to accept the Rutherglen figures as any criterion as to what should be done at Benalla for wheat, the land there should be ploughed to a depth of at least 5 inches as early as convenient after the winter. The harrows should then be used as soon as possible. In the spring the land should be worked down with the lightest implement consistent with weed killing and handling the clods, and the surface kept loose to a depth of 3 inches as required. The greatest pains should be taken to work the soil on the moist side, and it should be left in a slightly cloddy condition so as to prevent the surface running together and setting. The use of the disc cultivator is often unavoidable; but where the spring-tooth and harrows can be substituted it is an advantage.

So much for the conclusions that can be drawn from the Rutherglen experiment field, but as time goes on the Benalla Agricultural Society hopes to learn much from the practices of local farmers, some of whom no doubt grow better crops than others.

### Results of the Competition.

FALLOW COMPETITION, BENALLA.

For best fallow not less than 30 acres.

| Name. | Soil Type. | Moisture. | Mulch. | Weeds. | Cultivation. | Total. |
|---|---|---|---|---|---|---|
| **Possible Points** .. | .. .. .. | **25** | **25** | **25** | **25** | **100** |
| F. Hall .. .. | Sandy loam .. | 22 | 18 | 25 | 23 | 88 |
| D. Smith (No. 1) .. | Clay loam .. | 17 | 22 | 25 | 20 | 84 |
| Henry Hill .. | Clay loam .. | 17 | 20 | 25 | 20 | 82 |
| D. Smith (No. 2) .. | Clay loam .. | 11 | 17 | 25 | 17 | 70 |

Mr. Hall's fallow was on a paddock containing loamy drifts, and is situated near the Broken Creek. It was highest in available moisture of any of those submitted, had been thoroughly cultivated, and was free from weeds. The mulch—disced to the full depth of the plough—appeared to be too deep (about 5 inches). Marks were accordingly heavily deducted, but that notwithstanding, this fallow scored so well in other sections as to win the first place. The reason why such a deep discing is undesirable is the difficulty likely to be experienced in securing a solid seed bed in so short a time before seeding.

The fallow was worked as follows:—Ploughed to 5½ inches in September and October, harrowed twice shortly after, harrowed in December, and disced deeply in January.

Mr. D. Smith's No. 1 entry was second. This fallow was not so high in moisture, and a few points were deducted on the score of uneven cultivation. It was ploughed 5 inches deep in September, then left till February and disced.

An interesting contrast in the value of a mulch in conserving moisture is afforded by Mr. Smith's two entries. One was mulched and the other was merely left in the sod. The mulched paddock contained one-third more moisture than the other.

It is not important, except in dry years, to conserve moisture from the year before for crop requirements in a climate like this, but it is necessary to keep the fallow moist during summer to allow of the process of plant food formation to take place; *e.g.*, soil bacteria do not work in a dry soil, hence little nitrate is prepared for the growing crop.

Mr. Henry Hill's clay loam had a very thin mulch, and the cultivation was rather patchy through the paddock having been allowed to set in patches before it was last harrowed.

### Farming at Goorambat and Stewarton.

Mr. D. Smith, of Goorambat, has 560 acres. He cultivates 120 acres of wheat, 30 acres of oats, and has about 120 acres of fallow annually. All wheat is now sown on fallow. The average yield is about 18 bushels. Major wheat, a variety raised by Mr. H. Pye, at Dookie College, is preferred. Three hundred sheep are kept.

The following rotation systems are practised:—Fallow, wheat, oats, fallow, and fallow, wheat, oats, grass, fallow. Mr. Smith works the fallow with a disc in spring, and with a spring-tooth if this implement will do the work before seeding. 70 lbs. of seed are used and 80 lbs. of superphosphate.

Mr. F. Hall has 384 acres—200 acres are cropped, 20 acres are in citrus trees, and there are 4 acres of lucerne. A Nunan spray system has been installed, primarily for the citrus, and is used on the lucerne. The fallow is well worked as a rule. 70 lbs. of seed are used with 100 lbs. of superphosphate. The rotation system is—fallow, wheat, oats, and fallow, wheat, fallow, wheat, grass.

Mr. Henry Hill, Stewarton, has 900 acres. As a rule, 200 acres are sown to wheat, and 70 acres to oats. Half the wheat is sown on fallow. The general practice is to fallow to 5 inches in August, September, and October, work the fallow well, and sow in May with 60 lbs. of wheat and 90 lbs. of superphosphate. Major is the kind of wheat preferred.

### Suggested Improvements at Benalla.

From a cursory inspection of the few farms seen, it is not safe to generalize. Further experience in the district may bring to light fresh facts. It is highly probable that Benalla wheat-growers would improve their yields by paying more attention to the following rules in cultivation:—Early harrowing of the fallows after the first ploughing; cultivation of the fallow early after heavy rains before the land dries out; reduction of the use of the disc cultivator, which breaks the land down too fine, especially if worked on dry land; the use of the spring-tooth cultivator for working fallows where possible. This implement leaves the clods on the surface, and sifts the finer earth below.

In sowing, it would probably pay to increase the rate of seeding to 80 to 90 lbs. per acre, and the amount of superphosphate to 1 to 1½ cwt. Harrowing after the crop is up should prove especially beneficial where the soil has set.

### The Cultivation of Lucerne.

Several lucerne paddocks were noticed at Benalla, grown entirely on the natural rainfall. Indeed, a good many exist in the north-east, notably at Violet Town, Euroa, Wangaratta, and Rutherglen. In this part of the State, a fair proportion of the rain can be expected in the summer months, hence it is specially favorable to summer crops like lucerne, and there are many thousands of acres in the north-east that could be profitably sown to lucerne.

Lucerne ought to do well at Benalla on any of the deep loamy soils; where these obtain, it would certainly pay to sow it. Lucerne is often difficult to "strike" the first time, but one failure should lead to a second attempt. Fallow the land deeply, work after rains to free it of all weeds; sow in spring in moist weather with Hunter River lucerne at the rate of 10 lbs. per acre. Use 1 cwt. of superphosphate. The seed bed should be fine and firm, and the lucerne sown at or near the surface. Mix the lucerne with the manure and sow through the manure run.

. . . . . .

In conclusion, I desire to commend the Benalla Society on being the first Agricultural Society in the north-east to commence the Crop and Fallow Competitions. It is to be hoped that the influence will ultimately extend to the Goulburn Valley.

I would also like to thank the Secretary, Mr. Monteath, and other officers of the Society, for their work in connexion with the judging.

# WEEDS AND THEIR ERADICATION.

(Continued from page 365.)

*By H. W. Davey, F.E.S., Orchard Supervision Branch, Department of Agriculture.*

**The Bracken Fern** (*Pteris aquilina*). Order: Polypodiaceæ.

The Ferns of Filicales are members of an extensive group of flowerless plants known as the Cryptogamia, of which the common Bracken, so well-known to most people, is an example. This fern has a world-wide distribution, and in many parts of Victoria takes possession of the ground to such an extent that it crowds out the better vegetation and becomes a most difficult pest to eradicate. Its black creeping rhizomes or root-stocks spread themselves through the ground in every direction and often to a considerable depth. The root-stocks are irregular branching stems, each of which ends in a small pale-

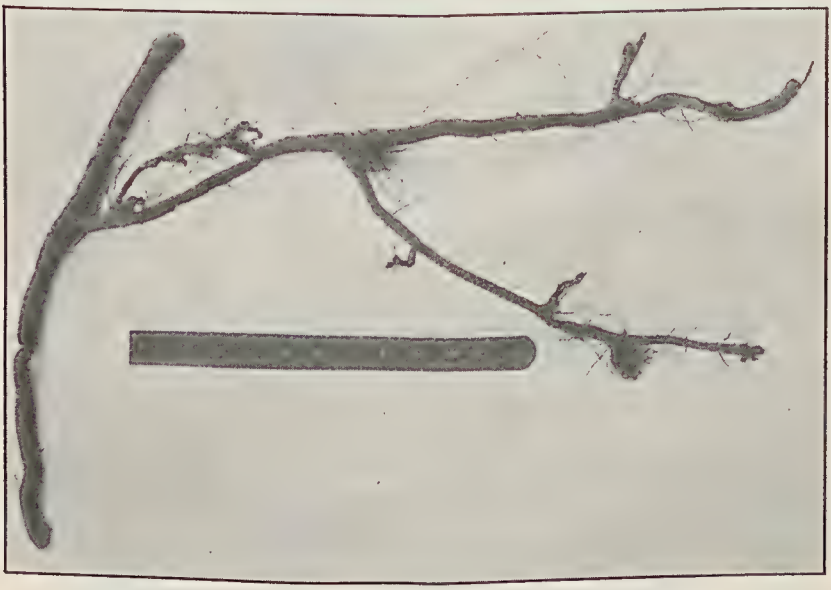


**Fig. 42.—Underground Root-stock or Rhizome of Bracken Fern.**

coloured growing point or knob from which it further extends itself through the soil. These underground stems creep mostly horizontally beneath the surface of ground (Fig. 42), sending up leaves year after year. Bracken ferns are herbaceous and perennial; the fronds die down, but are continually replaced from the underground root-stocks which cross and recross each other beneath the soil in all directions, often quite filling the surface soil with their masses.

New fronds will arise from the stems (Figs. 43, 44) at intervals, and some will later on produce spores for the further reproduction and dispersal of the species. These fertile fronds are easily recognisable by their characteristic bronze colour, mostly due to the masses of sporangia (spore vessels) clustered thickly on the underside of the leaves. If the underside of one of these leaves be examined during summer or early autumn it will be found to have incurved edges, which

more or less hide the spore-cases from view. As these innumerable spores mature, the reflexed margins of the leaves straighten out and expose the spores to view and liberates them.

Bracken ferns often become a serious pest on hilly forest land that has been cleared of heavy timber, the ferns rapidly taking entire possession of the ground before grasses can be successfully established. Ferns need not be allowed to establish themselves on land that can be cultivated, and even when growths are heavy on this class of land, there is no better method of clearing it than by cultivation, and afterwards raking off and burning the masses of rhizomes exposed by the plough.

Bracken, like most ferns, is intolerant of lime, and applications of the latter after cutting the ferns will assist very materially in their suppression; this at the same time will encourage the growth of clovers and grasses. Anything making for the improvement of the grasses, such as liming and manuring, will help in the eradication of this fern.

**Fig. 43.—Fronds arising from Root-stocks of Bracken Fern.**

The usual practice adopted for controlling bracken fern is cutting, but this work is very often carried out irrespective of the condition of the plant. Very few people would wait until such plants as St. John's Wort or Stinkwort were in seed before cutting them down, as this would only tend to scatter the seed, yet in the case of fern cutting this is often done. The best time to make the first cutting of bracken is as soon as the sporangia previously mentioned makes its appearance. The spores are the reproductive organs, and the fern has to draw heavily on its root-stock for their development, so that cutting ferns at this time will not only stop spore production, but also has a very weakening effect on the root-stock. After cutting down the ferns it will not be very long before a second crop of leaves makes their appearance; these should also be cut before any of them have an opportunity to produce spores; such cutting will also give the root-stock a further

weakening. This second and also cuttings during the following season are easier and quicker to do owing to the tenderness of the new fronds.

Some land-owners heavily stock their land after fern cutting, as the young leaves or crosiers arising later are then very soft and brittle, and are easily destroyed by the trampling of stock. In fact, any method of bruising fern stems whether by means of stock or farm implements has a most weakening effect on the root-stocks.

**Fig. 44.—Fronds arising from Small Root-stocks of Bracken Fern.**

Arsenical preparations have not much effect on bracken unless applied several times. In experiments in destroying St. John's Wort, it was found that the fern could survive applications heavy enough to kill the wort.

Dry salt applications after cutting the ferns gave much better results, and if stock had been available in these tests, the results in all probability would have been even better.

The following extract from *Farmers' Bulletin* No. 687, United States Department of Agriculture, is of interest:—

"Experiments were made in 1912 and 1913 to test the efficacy of spraying as compared with cutting and to learn the best method of obtaining a stand of grass and clover on the fern-infested areas. The spray materials used were solutions of salt, arsenite of soda, and iron sulphate. These materials were used in quantities of equal value. The results of these tests showed the following facts:—Salt is the best spray material of the three. With ferns at an average degree of thickness on the land, 150 pounds of salt dissolved in 60 gallons or more of water to the acre for each application are sufficient. Two sprayings a year are about as effective as four, and are to be recommended. Cutting is somewhat cheaper than spraying. Furthermore, the cutting does not interfere with young clover and grass coming in on the infested patches after the first treatment. This method, therefore, is to be recommended in preference to spraying in most situations. In some places the land is so stony as to interfere with cutting, in which case spraying may be the best method. It was found that scattering seed in the patches where ferns had grown was the most important means of getting a stand of grass and clover, and that liming and fertilizing in addition to the seeding were of considerable benefit."

(*To be continued.*)

## THE VALUE OF CHEESE AS A FOOD.

Dr. Bishop, a well-known New York specialist on diseases of the heart, in a book he has just written, cannot emphasize enough the wonderful power of cheese as an item in the diet of human beings. It is of the utmost importance, he says, in combating diseases of the heart and preventing a subsequent breakdown of the body. What cheese does not contain for the necessary nourishment of the body is supplied by bread, so that a cheese sandwich represents everything required by the human frame to keep it in health and strength.

Professor Sohn, in his book "Nutrition," writes: "One pound of cheese contains as much nourishment as 1½ lb. of lean meat; and 6 oz. of cheese with 24 oz. of bread will supply all the food nutrients required in twenty-four hours by an average grown-up individual."

Although cheese is probably the oldest of the dairy products, and has been a staple food with many races for countless years, the tendency has somehow got about to regard it as suitable for use only in small quantities."

We in Britain make use of cheese much more freely and in much larger quantities than they do in America. Cheese and bread form part of the midday meals of our hardest workers, and they can testify to its powers of nourishment and its ability to build up bone and muscle. During the war our coal supply was seriously threatened by the shortage of cheese, and the miners' ration of that commodity had to be materially increased before the threatened danger was averted.

# POTATO EXPERIMENTS, 1921-22.

*J. T. Ramsay, Potato Expert.*

The results of the experimental work for the past season are presented herewith.

The trials were conducted at Millbrook, Thorpdale, Trentham, and Modella, the soils of the first three being red volcanic, and that of the latter grey swamp loam.

The trials included manure tests, variety tests, immature *versus* ripe seed, and selected *versus* unselected seed.

## Selected Seed Test.

The outstanding feature of the trials is the result obtained from selection of seed.

At Millbrook three classes of seed were procured from the crop. These were as follows:—

I. Seed from plants producing a crop of 7 tubers and over.

II. Seed from plants producing 4 to 6 tubers.

III. Seed from plants producing 3 tubers and under.

These three classes of seed were planted under the same conditions and yielded as follows:—

| Standard of Seed. | Per cent. of Crop producing 7 and over. | Yield per Acre. |
|---|---|---|
| | | t. c. q. l. |
| 7 and over .. .. .. .. | 61 % | 6 5 0 0 |
| 4 to 6 .. .. .. .. | 15 % | 4 16 0 0 |
| 3 and under .. .. .. | 7 % | 4 5 0 0 |

## Immature v. Ripe Seed Test.

This test was made at Millbrook, with the following result:—

| Variety. | Immature Seed. | Ripe Seed. | Increase due to Immature Seed. |
|---|---|---|---|
| | t. c. q. | t. c. q. | t. c. q. |
| Red Ohio .. .. | 4 5 0 | 3 0 0 | 1 5 0 |

## Variety Tests, Millbrook.

| Variety. | t. | c. | qrs. | lbs. |
|---|---|---|---|---|
| Factor .. .. .. .. .. | 3 | 16 | 1 | 0 |
| American Wonder .. .. .. .. | 3 | 0 | 1 | 0 |
| Duchess .. .. .. .. .. | 5 | 5 | 1 | 0 |
| Brown's River .. .. .. .. | 3 | 0 | 1 | 0 |
| Red Ohio .. .. .. .. | 4 | 5 | 0 | 0 |
| Dates .. .. .. .. .. | 3 | 5 | 0 | 0 |
| Carmen III. Selected .. .. .. | 6 | 5 | 0 | 0 |

## Manurial Trials.

### I.—MILLBROOK.

| Plot. | —— | Weight of Row. | Weight per Acre. | | | |
|---|---|---|---|---|---|---|
| | | lbs. | t. | c. | qrs. | lbs. |
| 1 | Super., 2½ cwt. per acre .. | 376 | 7 | 11 | 0 | 8 |
| 2 | Super. and Sulph. Amm., 1 cwt. | 325 | 6 | 10 | 2 | 9 |
| 3 | Super., 5 cwt. .. .. .. | 325 | 6 | 10 | 2 | 9 |
| 4 | Market Garden, 2½ cwt. .. | 376 | 7 | 1 | 0 | 8 |
| 5 | Market Garden, 5 cwt. .. | 356 | 7 | 3 | 0 | 4 |
| 6 | Basic Super, 5 cwt. .. .. | 290 | 5 | 14 | 2 | 26 |
| 7 | No Manure .. .. .. | 290 | 5 | 14 | 2 | 26 |

### II.—CHILDERS.

| Plot. | —— | Section Weight. | Weight per Acre. | | | |
|---|---|---|---|---|---|---|
| | | lbs. | t. | c. | qrs. | lbs. |
| | *Limed.* | | | | | |
| 1 | 5 cwt. Super. per acre .. | 106 | 7 | 19 | 0 | 0 |
| 2 | 5 cwt. Nitro Super. per acre .. | 100 | 7 | 10 | 0 | 0 |
| 3 | 2 cwt. Sulph. Ammonia .. | 63 | 4 | 14 | 2 | 0 |
| 4 | 5 cwt. Market Garden Manure .. | 95 | 7 | 2 | 2 | 0 |
| 5 | No Manure .. .. .. | 70 | 5 | 5 | 0 | 0 |
| 6 | 5 cwt. Basic Super. .. .. | 95 | 7 | 2 | 2 | 0 |
| 7 | No Manure .. .. .. | 70 | 5 | 5 | 0 | 0 |
| | *Not Limed.* | | | | | |
| 1 | 5 cwt. Super. per acre .. | 96 | 7 | 4 | 0 | 0 |
| 2 | 5 cwt. Nitro Super. per acre .. | 100 | 7 | 10 | 0 | 0 |
| 3 | 2 cwt. Sulph. Ammonia .. | 53 | 3 | 19 | 2 | 0 |
| 4 | 5 cwt. Market Garden Manure .. | 93 | 6 | 19 | 2 | 0 |
| 5 | No Manure .. .. .. | 70 | 5 | 5 | 0 | 0 |
| 6 | 5 cwt. Basic Super. .. .. | 101 | 7 | 11 | 2 | 0 |
| 7 | No Manure .. .. .. | 70 | 5 | 5 | 0 | 0 |

## III.—TRENTHAM.

| Plot. | Manure per Acre. | Yield. | | | Increase. | | |
|---|---|---|---|---|---|---|---|
| | | t. | c. | q. | t. | c. | q. |
| 1 | 2½ cwt. Super. .. .. | 4 | 18 | 0 | 1 | 10 | 0 |
| 2 | 2½ cwt. Super. .. / 1 cwt. Amm. Sulph. .. | 4 | 19 | 0 | 1 | 11 | 0 |
| 3 | 5 cwt. Super. .. .. | 4 | 17 | 0 | 1 | 9 | 0 |
| 4 | 2½ cwt. Market Garden Manure .. | 4 | 17 | 0 | 1 | 9 | 0 |
| 5 | 5 cwt. Market Garden Manure .. | 5 | 7 | 0 | 1 | 19 | 0 |
| 6 | 5 cwt. Basic Phos. .. .. | 4 | 5 | 0 | 0 | 17 | 0 |
| 7 | No Manure .. .. .. | 3 | 8 | 0 | | Nil | |

## IV.—MODELLA.

| Plot. | Manure per Acre. | Not Limed. | | | | | | Limed with 10 cwt. per Acre. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Cut Seed. | | | Whole Seed. | | | Cut Seed. | | | Whole Seed. | | |
| | | t. | c. | qr. | t. | c. | qr. | t. | c. | qr. | t. | c. | qr. |
| 1 | 5 cwt. Super. .. .. | 2 | 14 | 3 | 3 | 2 | 2 | 2 | 11 | 2 | 3 | 2 | 2 |
| 2 | 5 cwt. Super. .. / 1 cwt. Sulph. Amm. | 2 | 14 | 3 | 3 | 2 | 2 | 2 | 11 | 2 | 3 | 2 | 2 |
| 3 | 5 cwt. Bone and Blood .. | 1 | 12 | 3 | 2 | 19 | 1 | 2 | 0 | 2 | 2 | 11 | 2 |
| 4 | 2½ cwt. Bone and Blood / 2½ cwt. Super. .. | 1 | 12 | 3 | 2 | 6 | 3 | 2 | 0 | 2 | 2 | 19 | 1 |
| 5 | 1 cwt. Sulph. Amm. .. | 2 | 0 | 2 | 2 | 19 | 1 | 2 | 6 | 3 | 2 | 19 | 1 |
| 6 | 5 cwt. Super. .. / 1 cwt. Sulp. Amm. / 1 cwt. Sulp. Potash | 2 | 19 | 1 | 3 | 18 | 0 | 2 | 16 | 1 | 4 | 7 | 2 |
| 7 | No Manure .. .. | 2 | 0 | 2 | 2 | 19 | 1 | 2 | 3 | 3 | 3 | 8 | 3 |
| | *Duplicate on Heavier Soil.* | | | | | | | | | | | | |
| 8 | 5 cwt. Super. .. .. | 2 | 16 | 1 | 3 | 5 | 0 | 3 | 8 | 3 | 3 | 18 | 0 |
| 9 | 5 cwt. Super. .. / 1 cwt. Sulph. Amm. | 2 | 3 | 3 | 4 | 7 | 2 | 3 | 8 | 3 | 4 | 12 | 1 |
| 10 | 5 cwt. Bone and Blood .. | 2 | 6 | 3 | 3 | 18 | 0 | 2 | 11 | 2 | 3 | 2 | 2 |
| 11 | 2½ cwt. Super. .. / 2½ cwt. Bone and Blood | 2 | 11 | 2 | 3 | 18 | 0 | 2 | 19 | 1 | 3 | 8 | 3 |
| 12 | 1 cwt. Sulp. Amm. .. | 2 | 3 | 3 | 3 | 8 | 3 | 2 | 11 | 2 | 3 | 8 | 3 |
| 13 | 5 cwt. Super. .. / 1 cwt. Sulp. Amm. / 1 cwt. Sulp. Potash | 2 | 14 | 3 | 3 | 5 | 0 | 3 | 2 | 2 | 4 | 7 | 2 |
| 14 | No Manure .. .. | 2 | 6 | | 2 | 19 | 1 | 2 | 3 | 3 | 2 | 19 | 1 |

NOTE.—There were 30 per cent. of misses in the cut seed, and 15 per cent. of misses in the whole seed.

# CASSE.*

## Wine Defects not directly caused by Micro-organisms.

*By F. de Castella, Government Viticulturist.*

Casse is the generic term given in France to a disorder or rather a group of disorders, occurring in the condition or colour of certain wines on their being exposed to air; disorders differing radically from wine diseases properly so called, which are directly caused by bacteria. Casse, on the other hand, is not characterized by the active presence of micro-organisms; it is due to chemical, as distinguished from biological, action.

The name itself may be literally translated as breakage (*casser*, to break). It indicates the breaking up or decomposition of the colouring matter, or other substances present in the wine, and their precipitation as a cloud or sediment. The French term is convenient, easily pronounced, and generally used in most wine-making countries. It seems, indeed, to have been Anglicised, since Webster defines it as "a disorder of certain wines, in which they lose most of their colour, depositing a reddish-brown sediment."

Condition trouble is not unknown in Australian and other cellars. A wine which is perfectly bright when bottled may sometimes become dull or cloudy after a while, throwing a sediment, so that, unless carefully decanted, it cannot be served in the attractive condition which usually characterizes such French wines as claret, chablis, &c. Casse, in one or other of its forms, is often responsible for this class of trouble.

In a valuable paper contributed by Mr. Leo Buring at the Sydney Congress two years ago, wine diseases of bacterial origin were dealt with, and the great value of pasteurization for their prevention and control was pointed out.

The present occasion seems opportune to deal with wine disorders of another class: viz., those of non-bacterial origin, briefly reviewing the state of œnological knowledge on the subject, and indicating the means by which such troubles can be avoided and combated.

Though the subject is fully dealt with in modern French books on wine,† there is little or no literature dealing with it in English.

It is hoped, therefore, that the present summary may prove of use to practical cellarmen.

### Historical.

In the history of casse, the investigation of the mechanism by which it is caused and the evolution of its treatment we have a striking example of the great practical use of scientific research to the wine-maker.

Prior to 1893, though the term "casse" was sometimes used, much confusion existed. Tour, a more or less synonymous term, was often confounded with tourne, pousse, and other bacterial wine diseases. Yet casse must often have given trouble previously. An ancient writer describes‡ how the wine of 1640 vintage was so bad that "we only

* Paper read at the Third Inter-State Wine Congress, Melbourne, June, 1922.

† Roos' "Wine Making in Hot Climates" devotes half-a-dozen pages to Casse, but this useful work was published when the question was being investigated and before the treatment was properly understood.

‡ *Revue de Viticulture*, Vol. XXXIX., p. 415 (March, 1913), a quotation from an old work entitled *L'Usance de Saintonge Entre Mer et Charente*, published in 1701.

drank it to keep us from dying." He mentions how, by a curious coincidence, exactly 100 years previously, "in 1540, the summer was so hot as to spoil the wines, hence it was called the year of the roasted wines." He speaks of them as *vins morfondus* (perished wine), and explains how "I never drank any of these sick wines except with displeasure, and having by nature the advantage of my taste being indifferent as to wine or water, I should a thousand times rather have gone to the fountain were it not that my sixty years would have led me to fear disorder and change in the economy of my health." He further explains that white wine was less sick than *clairet* (red wine), whence he concludes that the first is male and the second female.

Incidentally it will be seen that the well-known French view that moderate use of wine is good for health does not date from yesterday.

The faulty wines of 1540 were undoubtedly affected with casse.

More recent writers deal with condition trouble, but usually in vague and sometimes curious terms; some have even gone near to the solution of the puzzle, for example, Vergnette-Lamotte.

In his book on wine (1868), he devotes a chapter to "tour," describing how affected wines become brown on exposure to air. If the disease is advanced they resemble brown beer rather than wine. The microscope reveals no special characteristics; "if the mycoderm of tour exists, it has not yet been described." He notes that faulty wines are often made from grapes so mouldy that its bad quality is not surprising, and recommends that mouldy grapes be treated as for white wine, and not fermented on the skins.

It was during the nineties of last century that the subject was cleared up. The wines of 1893 vintage in Southern France were very subject to casse. The disorder was discussed at meetings of the Hérault Agricultural Society at Montpellier. Bouffard attributed the trouble to the sudden precipitation of the colouring matter on exposure to air. Others considered it to be caused by micro-organisms. Armand Gautier* inclined to this view, though he admitted that casse is quite different from tourne. He gave an excellent description of the manifestations characterizing the change, noting that it only occurs after the first racking; so long as the wine is not exposed to air it keeps well. He further stated that the trouble is more pronounced in warm autumns when moulds invade the grapes.

Bouffard's investigations are of the greatest interest. At the same society's meeting in March, 1894, he disagreed with Gautier, holding that casse is not caused by bacteria. He recommended pasteurization and the use of sulphurous acid ($SO_2$). His treatment is fully described in a communication to the French Académie des Sciences of 9th April, 1894, which is the basis of that recommended by later writers.†

It is worthy of note that Bouffard discovered the treatment before the exact nature of the change or the agency causing it were understood.

Gouirand, in a communication to the Académie des Sciences (22nd April, 1895), showed that casse is due to an enzyme or soluble ferment

* *Revue de Viticulture*, 17th March, 1894.

† Independently of, though almost simultaneously with Bouffard, Müller-Thurgau, the well-known Swiss authority on wine, arrived at remarkably similar conclusions concerning casse, which he published in April, 1894, in *Mittheilungen Über Weinbau und Kellerwirtschaft*. He attributes the prevalence, in 1893, of this imperfectly known trouble to the very hot summer and early ripening grapes, poor in acid. Pasteurization at 60° C. of the clear wine prevents casse, even if the wine be afterwards exposed to air. Of other treatments, he prefers vigorous sulphuring, the wine being pumped into a cask in which sulphur was burnt at the rate of 1.5 grammes per hectoliter. Early treatment is essential.

present in the wine, since named oxydase, which brings about the oxydation and precipitation of the colouring matter of red wine, and changes that of white wine to deep yellow, or even brown in extreme cases.

The enzyme can be precipitated by alcohol; a small proportion added to a normal wine renders it liable to casse. If, however, after such addition, the wine be heated to 80° C., it is no longer thus liable; the enzyme is destroyed by heating. Thus was explained the preventive action of pasteurization previously discovered by Bouffard.

Though Gouirand found the cause of the change, he failed to trace its origin. He notes that red and white wines liable to casse often contain bacteria, and asks if these may not secrete, either in vat or cask, the enzyme responsible for the trouble. He also suggests that it may be produced by yeasts working under faulty conditions, or that it may pre-exist in grapes ripened under certain conditions. In an article in *La Revue de Viticulture* (10th October, 1896), on the yellowing of white wine, he points out the identity of this change with the browning of red wines, but the source of the enzyme still escapes him.

To Laborde is due the credit* of discovering that the main source of the enzyme is the grey mould fungus, known as *Botrytis cinerea,* the noble-rot of the grape in the vineyards of Sauternes, the Rhine, &c. He showed how culture liquids of this fungus, added to normal wines, induced casse. Heated to 85°, however, they lose this power. Though he considers this fungus to be mainly responsible for the presence of oxydase, he agrees with Martinand that it exists normally in the grape; much of it is eliminated during fermentation, the small proportion remaining playing an important part in the normal ageing of wine.

Thus was the riddle solved and the explanation given of the connexion, noted by older writers, between casse and wet vintages with mouldy grapes.

In the foregoing we have only considered brown, yellow, or enzymic casse due to the presence of oxydase. There are, however, other forms, the causes of which are altogether different. Amongst these the most important is blue or ferric casse, due to the presence of an excess of iron in the wine. Such a wine, on exposure to air, becomes dull and dark, even assuming a bluish tint, as if a little ink had been poured into it. Ink, in fact, it really is, in the shape of iron combined with the tannin of the wine. On exposure to air the colourless ferrous tannate becomes oxydized to blue-black ferric tannate, or ink.

The investigation of blue casse and the evolution of our knowledge concerning it is not marked by such sensational stages as that of the enzymic form.

It was long known that there was some connexion between the presence of iron in the wine and the development of a blackish or bluish tint on its exposure to air, and also that wines low in acid are more liable to such change. The unstable colour of wine made from Jacquez was correctly attributed to high iron content and low acidity.

So long ago as 1846 Batillat recommended the addition of tartaric acid to wines liable to blue casse, and in 1897 Bouffard advised similar treatment, the exact dose to be determined by preliminary trials on small quantities of the wine. He also recorded the uselessness of pasteurization to prevent this form.

* Communication to French Académie des Sciences of 11th December, 1896.

No doubt in bygone years, when scrupulous care was taken to avoid contact of wine or grapes with metal, blue casse was much less frequent than it is to-day.

### The Different Forms of Casse.

In addition to the brown and the blue forms already mentioned, there are other forms, concerning which our knowledge is less definite.

*White casse* is characterized by a white or opalescent cloud which develops after aeration. Though differing in appearance it is rather closely related to blue casse, being also due to iron in excess.

*Bacterial casse* is mentioned in most French wine books. There seem to be several different forms of it, some of which resemble brown casse, in that they seem to be of enzymic nature, the enzyme, however, being secreted by bacteria. This group would thus form a connecting link between casse and the ordinary wine diseases caused directly by micro-organisms.

*Mousiness.*—This abominable development seems to me to be a form of casse, for reasons which will be specified later.

*Aldehydic casse.*—Normal maturation is often held to be due to traces of oxydase which remain in the wine. Another view is that it is due to the action of aldehydes, of which small quantities are present in wine, especially in old wines.

It may, of course, happen that a wine may not be affected by one form alone; it is quite possible for two or even more forms to exist simultaneously, in which case the diagnosis of the trouble and its treatment may become somewhat complicated.

Brown and blue casse are the best known and most familiar forms. They must now be considered in greater detail, and their treatment explained.

### Brown, Yellow, or Oxydasic Casse.

We have seen how brown casse is due to the presence of an enzyme known as oxydase. The symptoms of the disorder are as follows:—

Cellarmen are familiar with certain red wines which, though quite bright before racking, lose their condition on being transferred to another cask, becoming, in bad cases, quite muddy. Such wines are affected by brown casse. In the original cask they are protected from contact with air, and no sediment forms. Aeration takes place on racking, and enables the oxydase to fix the oxygen on part of the colouring matter and tannin, which, becoming insoluble, form a sediment. After a rest of a few weeks the wine may again become clear, but it will be reduced in colour and of a different tint, having changed from the purple-red of a young wine to a more or less tawny red, or, in extreme cases, to a brown sherry colour. Simultaneously with these changes, the flavour and bouquet are modified, as will be seen presently. If a sample be drawn from the cask in its bright condition, before racking, and allowed to remain in a large glass half-full and covered with a card, it will be noticed to become cloudy after a while, the length of time depending on its liability to casse—in other words, to the amount of oxydase it contains. In very bad cases, condition will be lost after a few hours, a metallic-looking film forming on the surface, the wine becoming quite muddy and of a brick-red colour; in less severe cases the wine will merely become cloudy after a time, varying from one to several days.

The amount of colouring matter and tannin precipitated is usually 1 or 2 centigrammes per litre, but it may be much more considerable, especially on prolonged exposure to air. According to Pacottet,* if, after breakage, the wine be further exposed for 36 or 48 hours, the whole of the tannin may be destroyed, even in wine containing up to 2 grammes per litre. Colouring matter is destroyed as well. He attributes the characteristic odour and flavour to oxydation products of these substances.

The microscope can here be used with advantage. If bacteria are absent it is certainly a case of casse and amenable to treatment described below. If bacteria are observed these may be responsible for the trouble. If present in any quantity, pasteurization should be applied.

White wines may also be liable, but casse then manifests itself by an increase instead of a loss of colour. From the original pale-yellow the wine becomes deeper in tone, even passing to brown, and throwing a muddy sediment in extreme cases. In wines of champagne or chablis types, which should be pale in colour, it is often known as "yellow disease."

Colour and condition are not alone affected, the bouquet and flavour of both red and white wines also undergo a change, the wine tastes flat and worn, even to the extent of acquiring a cooked taste, reminding of prunes.

Casse may, in fact, be assimilated to premature old age. In lesser degree the change may only amount to what is known in French as *madérisation,* and which, though essential in a madeira or a brown sherry, is quite out of place in a light delicate wine. This change is akin, if, indeed, not identical with, the development of a *Rancio* or porty character in many sweet wines.

Casse does not affect the alcohol, acids or sugar contained in the wine, hence it is that wines even badly affected are not unsound in the ordinary sense of the word; there is no increase in volatile acidity.

Whether in red wine or white wine, casse is seldom observed during the first few months after vintage; so long as it contains much carbonic acid, this protects the wine from atmospheric oxygen. It is only after exposure to air in racking that the change can take place.

### What is Oxydase? Where Does it Come From?

The particular enzyme which causes brown casse has been named oxydase, since its function is to fix the oxygen of the air on the colouring matter and tannin of the wine. It is a chemical or soluble ferment as distinguished from organized or living ferments such as we know in yeast or the different wine disease bacteria.

Soluble ferments or enzymes belong to a group of substances common in the vegetable, also in the animal kingdom. We have an example in diastase of malt, which transforms the non-fermentable starch of the barley into maltose, a fermentable sugar. Likewise in myrosin of mustard. Dry mustard lacks the familiar pungent smell which it only acquires when, on mixing with water, the myrosin is enabled to set free the essential oil of mustard. The oxydation of lacquer by laccase is yet another example rather more similar to casse, since it is an oxydation phenomenon, as is also the browning of sliced apples exposed to air. This

* *Vinification*, p. 268.

last is an almost identical change, and is countered by $SO_2$, so largely used also, in the treatment of wines liable to casse. A noteworthy feature common to soluble ferments is that a very small quantity is capable of bringing about a change or fermentation in a large bulk of the substance it can act upon.

Oxydase, like other enzymes, is a curious substance of complex and rather obscure composition. As it has not been isolated in a state of purity, its exact chemical composition is unknown. It can be precipitated from a wine containing it by adding three times its bulk of 90 per cent. alcohol—a small quantity of the precipitate redissolved in water and added to a normal wine will induce casse.

In common with other oxydizing enzymes, it communicates a blue tint to tincture of guaiacum made milky with water, a property at one time utilized as a test, though with rather unsatisfactory results.

Oxydase seems to be of a somewhat gelatinous nature, and to exist in the wine in a state of more or less semi-solution, hence it is removed, in part at least, by fining and filtration. In carrying out its damaging action (oxydation of colour and tannin) it is itself destroyed; hence it is gradually eliminated with age, but if present in excess, colour, &c., will be severely damaged before its disappearance.

The presence of this queer substance in the wine may originate in several ways. According to most authorities, it is, in small quantity, a normal constituent of all grapes, as also of apples and other fruit. During fermentation most of it is destroyed, only traces remaining in a properly constituted wine. Such very small quantities are usually considered desirable, and even necessary, for the normal maturing of wine, the characteristic changes of which only differ in degree from brown casse. In the latter case, the change is sudden and brutal instead of being slow and gradual and of very slight extent. In port, madeira, and rancio wines, a certain amount of casse seems even beneficial. It is only when too violent, or occurring in a wine from which it should be absent, that it is undesirable.

Bouffard* drew attention to two marked points of difference between casse and normal maturation. 1st, as regards time.—Ageing extends over months or even years, whereas the changes characteristic of casse occur within a few hours, or, at most, a couple of days after aeration. 2nd, the action of heat.—Pasteurization, even at 100° C. (212° F.), which altogether prevents casse, does not interfere with normal maturation.

The true part played by oxydase in normal maturation—whether it is responsible for the whole or only a part of the changes just outlined—is not altogether clear. Aldehydes are capable of causing very similar changes, as will be shown in connexion with aldehydic casse. More particularly in tawny and rancio wines these substances no doubt play a very large part.

The proportion of oxydase present in the grape varies greatly, according to the season, the vine variety, and the soil on which it is grown.

It is undesirably plentiful in seasons when ripening does not take place under normal conditions. In Bordeaux, 1893 was a very hot year, the grapes ripening much earlier than usual. The wines of that vintage were

* *R. Vit.*, XV., p. 373, 6th April, 1901.

very liable to casse. Over-ripe and sun-scorched grapes are thus liable to contain it in excess, a fact which should not be lost sight of when making dry wines in our warmer districts.

Oxydase must be far more plentiful in some grapes than in others. Varieties such as Grenache and Bastardo, the wines from which soon become tawny, probably contain more than those of stable colour.

The influence of soil seems to be considerable. The same variety grown on two different soils may yield wines which vary enormously in their liability to become tawny. Grenache grown on slate or schists undergoes this change at an early age; grown on limestone soil its colour is much more stable.

The most important source of oxydase is, without question, mould on the grapes at vintage time. We have seen how the close connexion between casse and mouldy grapes was realized long before the nature of the change was understood. Ordinary grey mould (*Botrytis cinerea*) produces it in great abundance. Blue mould (*Penicilium glaucum*), curiously enough, does not secrete it, though it gives a very bad taste to the resulting wine.

Mouldy grapes are particularly undesirable for red wine. Many excellent white wines are habitually made from very mouldy grapes; those of Sauternes and the Rhine, for example. The cellar methods peculiar to these districts, an outstanding feature of which is the lavish use of $SO_2$, inhibiting the action of oxydase. In mouldy vintages it is well to convert red grapes into white wine, and to sulphite rather heavily. It is thus possible to make a wine of paler colour than from sound grapes, if aeration of the must be active. Martinand's method of making white wine from red grapes is based on taking advantage of the oxydase present in fresh grapes, and by energetic aeration, causing it to precipitate the remnant of colour retained in the juice of rapidly pressed red grapes.

Bouffard describes how Martinand's process "often fails with sound grapes; what little oxydase the fruit contains, being oxydized and destroyed before the colouring matter can be eliminated. Excellent white wines (from red grapes) can be made in mouldy vintages: the oxydation of the rosy juice is then easy."

### Treatment of Wines Liable to Oxydasic Casse.

Brown casse cannot be cured, though it can be prevented. Once the colour has broken and been precipitated, nothing can be done to restore it. The wine may, it is true, be blended with one rich in colour, but before this can be done with safety any oxydase which remains in it must be destroyed or rendered harmless.

The yellow colour induced in a white wine can be removed, or at least reduced considerably, by treatment with fresh lees of first fermentation, which have the property of fixing a good deal of the yellow pigment. Manceau† recommends 5 to 6 gallons of thick lees from a sound young wine at its first racking, to 200 gallons of the yellow wine, with thorough rousing; after a fortnight's rest, the wine is racked and fined.

Whether the wine be red or white, prevention is the best course. Wines liable to casse, even those containing a good deal of oxydase, can be so treated as to insure protection from undesirable change. They

* *R. Vit.*, XV., p. 372, 6th April, 1901.
† *Œnologie Champenoise-Notes et Documents*, p. 63.

must, above all, be taken in time; the oxydase must be destroyed before it has been able to damage the wine.

Acids hinder the action of oxydase, but only at fairly high doses, so high as to be impracticable, since it requires 1 per cent. of citric or tartaric acid. .2 per cent. of sulphuric acid suffices, but the addition of this acid to wine is out of the question. Sulphurous acid only acts temporarily, but, as will be shown presently, its use in conjunction with aeration is of the greatest value.

Wines which were sulphited at vintage time are less liable to casse than those not so treated. Preliminary maceration and the very heavy sulphiting it entails should greatly reduce liability to casse by direct destruction of much or most of the oxydase present in the grapes. Plastering, likewise, seems to have a preventive action. Pacottet* states that wines containing more than 4 grammes of potassium sulphate per litre (double our legal limit) are seldom liable to casse.

Two distinct methods of treatment are available—both preventive—viz., pasteurization and combined treatment by means of $SO_2$ and aeration.

*Pasteurization,* though the less frequent method, certainly seems a most logical one. It is radical and expeditious. Oxydase is destroyed by heat; unfortunately a rather high temperature is necessary. Authorities are not altogether in agreement on the subject. Laborde recommends 70° to 85° C. (158° to 185° F.) for at least a quarter of a minute. According to Pacottet†, 5 minutes at 70° to 80° C. (158° to 176° F.) are required. Other writers are content with less. The temperature required depends on the liability to casse, in other words, on the proportion of oxydase present; but also on the composition of the wine, its acid content, &c.

It is to be regretted that pasteurizers are not so generally used in our cellars as is desirable, nor are they all capable of heating to a sufficiently high temperature. Mr. Buring has filled a want in devising a pasteurizer which meets all requirements. Before pasteurizing it is usually necessary to filter the young wine, and this must be done with due precautions against exposure to air, otherwise colour, &c., would be damaged before the oxydase is rendered innocuous.

### Aeration in Presence of $SO_2$.

In this we have what may be termed the standard treatment, the one most often followed; it comprises two distinct stages:—

I. Protection from the action of oxydase.
II. Destruction of oxydase.

*Protection* is insured so long as the young wine is denied access to air; so long as it retains sufficient carbonic acid it is safe. But young wines must be racked. Fortunately we have a most convenient protective agent in sulphurous acid or $SO_2$, which is even more hungry for oxygen than the colouring matter, &c., spurred on by oxydase. Provided the wine, when racked, contains a little free $SO_2$, it will altogether protect

* *Vinification* (1904), p. 269.
† *Revue de Viticulture*, 2nd November, 1905.

the colour and tannin of the wine. The dose varies from 2 to 8 centigrammes* per litre of $SO_2$, or double those quantities of bisulphite, it is determined by the air test described below.

*Destruction of Oxydase.*—It was thought at one time that $SO_2$ destroys oxydase. No doubt it has some action in this direction, but only if present in such quantity as to be quite out of the question. Even at 5 centigrammes per litre it is only a restrainer, and a temporary one at that, owing to its instability and its early disappearance in active form.†

It is the oxygen of the air which is the most effectual destroyer; but this agent can only be safely employed whilst the damaging action of oxydase is inhibited by the temporary presence of small quantities of free $SO_2$. Oxydase, which acts as a conveyor of oxygen to colour and tannin, is itself destroyed in the process, being oxydized and rendered innocuous. If a wine liable to casse, but protected by a small dose of free $SO_2$, be aerated, the oxydase is destroyed without colour, &c., suffering. Thus is explained the standard treatment.

The almost gelatinous nature of oxydase, and its more or less imperfect state of solution in the wine, have been referred to, as well as the action of fining and filtration in eliminating it, at least partially. It follows that ordinary cellar manipulations gradually remove it from the wine; but such removal is gradual, it takes time; it is not immediate as in the case of pasteurization, and during the whole of the time over which elimination extends the wine must be protected by free $SO_2$.

Treatment of casse on these lines must, however, be applied judiciously; after the addition of $SO_2$, aeration must not be too long delayed, nor must it, on the other hand, be exaggerated.

As already pointed out, it is not the $SO_2$ which destroys the oxydase, but the oxygen of the air. Hence the wine must be exposed to air soon after the addition of $SO_2$ and before it has been able to enter into the combined form. To quote Laborde‡:—

"If the presence of $SO_2$ in the free state is not utilized early enough or completely enough, the wine only receiving a tardy or incomplete aeration, or none at all, the complete cure of the trouble will not be achieved with the minimum dose necessary." He quotes a case reported by Moreau, who introduced into a wine, liable to casse, and protected for three years from contact with air, the heavy dose of 28 cgms. of bisulphite without effecting a cure. On the other hand, the same wine, bisulphited at a dose very near the minimum, which was 12 cgms., and aerated shortly after, always held (its condition); a result which proves conclusively that the contact alone with $SO_2$ does not suffice to destroy the properties of oxydase."

Nor must aeration be too active. According to the same writer, "Contrary to what might be inferred from the above, excessive aeration after addition of $SO_2$ may also be a cause of non-success of the treatment.

The destruction of oxydase by air is, in fact, less rapid than the oxydation of $SO_2$. If follows that if the wine were to receive excessive or too sudden aeration, the $SO_2$ would disappear too rapidly and there would no longer be

* In the following pages, wherever the word centigramme (or its abbreviation, cgms.) occurs, it refers to centigrammes per litre, this being the most convenient way of expressing such small proportions as those in which $SO_2$ is added to wine. In an appendix will be found a table of correspondence with English weights and measures.

† The elimination of free $SO_2$ takes place in three distinct ways. Part is directly evaporated when the wine is racked. Part is oxydized to sulphuric acid, which, combining with the potassic salts in the wine, remains as sulphate of potassium. The balance enters into combination with aldehydes, sugar, and other constituents of the wine, assuming the form known as combined $SO_2$, in which it has but little effect on oxydase. Of the two sugars present in wine, $SO_2$ only enters into combination with dextrose; it does not combine with levulose.

‡ *R. Vit.*, XXIV., 496, 2nd November, 1905—La Casse du Vin et ses Traitements.

equilibrium between its oxydation and that of the oxydase. The result of the treatment would then be equivalent to an insufficient addition of $SO_2$."

Laborde recommends the addition to the wine of a little more than the minimum dose of $SO_2$ determined by the air test (see p. 428), so as to allow for oxydation of portion during the manipulations necessary on a large scale; one-quarter or one-third over and above the minimum may thus be safely added.

The following further extracts from the same article are of practical interest:—

"The bisulphite, dissolved in a little water or wine, is placed in the cask into which the wine will be racked, so that receiving (its dose of $SO_2$) immediately after being aerated, any oxygen absorbed during racking is powerless to cause casse, but is, on the contrary, favorable to the elimination of the oxydase." In mild cases this preliminary aeration often suffices, but when casse is more pronounced, it is necessary to repeat the aeration, after a week or two, by racking with abundant exposure to air. "This second aeration . . . . may also be effected by pumping air into the wine in the cask . . . . the volume of air should be at least equal to the volume of the wine." After . . . . at least a month, the wine should be again tried by the air test. If it no longer shows casse, it may be fined."

Wines very liable to casse long remain cloudy, even after being cured. This cloudiness may be due to two causes: to bacteria of tourne or to the presence of viscous matter or dextrane, produced by the botrytis fungus. It is this dextrane, more particularly, which prevents fining from being effective, even after addition of tannin. . . . If the wine is not affected with tourne, a long rest will always bring about the settling down of the slimy matter, with complete clarification, but it may be necessary to wait six months or a year. The only means of obtaining more rapid clearing is by filtering with the aid of infusorial earth to coat the filter bags, this being the only material which renders filtration possible in cases where dextrane is abundant, and where, in consequence, the clogging of the bags occurs with extreme rapidity."

Infusorial earth does not seem to be employed to any extent for filtering in Australian cellars. It lends itself more particularly to use in bag filters (as opposed to cellulose or wood pulp filters). Its addition to the finings, used for coating the filter bags, seems to have been first suggested by Laborde* in 1904.

Infusorial, or more correctly, diatomaceous earth, consists almost exclusively of the siliceous skeletons of diatoms (microscopic vegetables); these are elongated, hollow, and angular, being very light they settle gradually, forming a felt-like sediment, which constitutes an excellent filtering medium, capable of stopping, not only very fine particles, but also substances in semi-solution, such as partially coagulated albuminous matter, &c.

If used alone, it has a tendency to detach itself from the bag-tissue, unless used for wine containing a mucilaginous cloud; hence, it needs the addition of a little gelatine or some similar fining. Semichon† recommends, per square yard of filtering surface, about one-seventh ounce of infusorial earth and 10 grains of gelatine (per square metre, 5 grammes infusorial earth, and .75 grammes gelatine). These substances are thoroughly mixed in the wine with which the filter is first filled.

Laborde‡ prefers white of egg or casein as a fixer. He recommends making a dry mixture of eight parts infusorial earth with one part each of soluble casein and tannin in very fine powder. This mixture, made into a smooth paste at the rate of nearly ½ ounce per square yard of filter surface (10 grammes per square metre), gave excellent results. At the fourth hogshead, the filter allowed the passage of five times as much wine as a similar filter coated with gelatine alone; in both cases the filtering surface was 2 square yards.

## The Air Test.

Before treating suspect wines, it is essential to ascertain their degree of liability; in other words, the minimum dose of $SO_2$ required for

* *R. Vit.*, XXI., p. 125, 4th February, 1904.
† *R. Vit.*, XXIII., p. 173, 16th February, 1905.
‡ *R. Vit.*, XXIII., p. 568, May, 1905.

adequate protection. It would be foolish to use 6 centigrammes where 2 would suffice. Young wines, made from grapes showing even traces of mould, or which, for any other reason, may be suspected of liability to casse, should be always tested before the winter racking, whether this be the first or second to which they will be subjected.

The simplest test consists in drawing a small sample from the cask and leaving it in a glass, half full, for a few days, covered with a card to keep out dust and insects. If after a couple of days the wine is still clear, no treatment is necessary. If the wine clouds and discolours, treatment must be adjusted to the intensity of the trouble.

Certain precautions should be observed, without which the indications afforded by the test are apt to be misleading. Young wines which have not quite finished fermenting will be protected by the carbonic acid they contain. If fermentation be at all audible at the bung-hole, testing should be postponed until it has entirely ceased. Wines containing much $CO_2$ can be easily aerated with a bicycle pump to which a rubber tube is fitted; a few strokes will drive off the $CO_2$ and insure the reliability of the test.

Semichon* recommends the use of several bottles in which are placed different doses of $SO_2$ (in the form of bisulphite) at the rate of 2, 3, 4, 5, and 6 centigrammes of $SO_2$ per litre. The bottles are completely filled and corked. After a couple of days' rest, to give the $SO_2$ time to act, the wines are exposed to air by half-emptying them and closing the mouth with a plug of cotton wool. If the wine with 3 centigrammes clouds slightly, whereas that with 4 remains clear, 4 centigrammes per litre is the minimum dose required.

Laborde recommends an air test slightly different from Semichon's. Samples are drawn in the same way, and to them are added increasing doses of bisulphite—1, 2, 3, &c., centigrammes of $SO_2$. Instead of waiting two days before aerating, however, the samples are at once exposed in shallow depth (half-an-inch or so) in flat-bottomed flasks. After 48 hours they are examined and the minimum dose of $SO_2$ noted.

A simple way of measuring such minute quantities is to make a 1 per cent. solution of bisulphite in water. Each cubic centimetre will then contain 1 centigramme of bisulphite, or half that quantity of $SO_2$. Pipettes are obtainable, graduated in tenths of a cubic centimetre. A 1 per cent. solution contains 4.375 grains, say 4½ grains per fluid ounce (av.). An ordinary wine bottle, or reputed quart, holds ¾ gallon, or 26⅔ fluid ounces, or 757⅔ c.c. A litre contains 1,000 c.c. If ordinary wine bottles are used, allowance must be made accordingly. The bisulphite solution must be quite fresh; it quickly loses its strength.

Weinmann recommends a direct test, without addition of $SO_2$, the liability to casse being gauged by the rapidity with which the colour changes. Two clear glass bottles are used, one filled completely and tightly corked as a control, the other half-full and closed with a plug of cotton wool or a piece of clean rag placed over it. If after four or five days the half-filled bottle remains clear, the wine is not liable to change. He divides liability to casse into 5 degrees or categories, as follows:—

1st Degree.—Wine becomes somewhat dull after four or five days' exposure.
2nd Degree.—Dull after one day's exposure, and cloudy after two or three days.
3rd Degree.—Dull after a few hours and cloudy after a day, the cloudiness increasing on the second and third days.

* *Traité des Maladies du Vin*, by L. Semichon, Director of the Œnological Station of Aude (France), 1905, p. 85.

4th Degree.—Formation of brownish-red iridescent film after a day's exposure, the wine becoming cloudy and of a brick-red colour.
5th Degree.—Colour changes after a few hours from reddish-brown to chocolate, the wine becoming very cloudy.

The treatment he recommends is as follows:—

1st and 2nd Degrees.—10 centigrammes per litre potash bisulphite.
3rd Degree (the most usual case).—12½ centigrammes bisulphite, 10 centigrammes citric acid, 5 centigrammes special tannin.
4th Degree.—12½ centigrammes bisulphite, 20 centigrammes citric acid, 8 centigrammes special tannin.
5th Degree.—15 centigrammes bisulphite, 30 centigrammes citric acid, 10 centigrammes special tannin.

## Practical Points

depend, necessarily, on the method of treatment to be applied. Two distinct cases must be considered.

I. *Pasteurization is Decided on.*—Though heating to 75° C. (167° F). usually suffices, it is better to experimentally ascertain the exact temperature required. The practical test suggested by Bouffard* is as follows:—Take five strong "baby" bottles (reputed half-pint), fill with the wine drawn direct from the cask, allowing enough room for expansion on heating, cork tightly and tie the corks securely. Through the cork of one of the bottles adapt an ordinary retort thermometer. Immerse the five bottles to within half-an-inch of the top of the corks, in a water bath and heat gradually. Withdraw the bottles progressively when the thermometer has, for half-a-minute, registered respectively 158°, 167°, 176°, and 185° Fahrenheit (equivalent to 70°, 75°, 80° and 85° Centigrade), marking each bottle accordingly. When cold, expose to air in a shallow depth, or even in an ordinary wine-glass covered with a card. The sample which no longer breaks on exposure, has been heated to a sufficient temperature. It is needless to pasteurize at a higher degree. If cloudy, the wine should be filtered before exposure to air (not before heating), an ordinary glass funnel with filter paper is all that is required.

Before pasteurization, the wine, if cloudy, should be filtered, with due protection against aeration during the process. Some authorities recommend to add a small dose of $SO_2$ before pasteurizing, thus combining the two methods; in this way, a lower temperature and a smaller dose of $SO_2$ will suffice than if either treatment were applied alone.

Pasteurization is especially appropriate if, as is sometimes the case, the wine shows symptoms of tourne or other bacterial trouble, in addition to casse.

II. *The Wine is to be Treated by $SO_2$, &c.*—The minimum dose of $SO_2$ being determined by one of the methods described above, the bisulphite containing it (twice as much as the dose of $SO_2$), must be dissolved in the wine before exposure to air—in other words, *before* racking. Laborde's advice to use a little more than the minimum dose (see p. 428), can be followed with advantage. One-fifth or one-quarter additional is an ample allowance.

Let us take as an example a 500-gallon cask of wine to be treated, proved by the air test to need a minimum dose of 3 centigrammes $SO_2$,

* *R. Vit.*, XV., p. 433, 20th April, 1901.

this would mean .96 ozs. of bisulphite per 100 gallons, or 4.8 ozs. for the whole cask. Allowing one-quarter additional, this would be increased to 6 ozs. for the 500-gallon cask. If the wine has already been racked,* and has little or no lees, the bisulphite, dissolved in a small quantity of water or wine, may be poured in through the bung-hole, with gentle rousing to distribute it through the bulk. If, however, the wine has not yet been racked at all, this course could not be followed without disturbing the lees. Under such circumstances, the most convenient way is by hanging the bisulphite, contained in a narrow muslin bag which can fit through the bung-hole, just below the surface of the wine. The bisulphite soon dissolves; after about a week, rack the cask with abundant exposure to air. A further racking a few weeks later is to be recommended. It may be replaced by aeration with the cellar pump (see p. 427), or better, with a motor tyre air pump, or even a bicycle pump. Fining or filtration may be applied a month later if the air test no longer shows liability to casse, though it is usually well to postpone it for a longer time.

Mathieu† does not favour the application of the bisulphite by the muslin-bag method. He holds that the solution sinks to the lees and does not diffuse properly through the wine. It is, nevertheless, recommended by such authorities as Bouffard, Semichon, &c. Tying the bag to a stick and moving it slowly round just beneath the surface until dissolved would insure better distribution.

Mathieu prefers placing the bisulphite (*dissolved* in a little water) in the cask into which the wine will be pumped, *racking being carried out without exposure to air.* This can be done by coupling the suction of the pump directly to the tap of the cask to be racked, the nozzle of the delivery being fitted with a piece of rubber, or even canvas hose, long enough to reach to the bottom of the cask to be filled. Without such an arrangement the wine, falling from top to bottom of the cask, would absorb a good deal of air.

Even when pumping from a tub, as may be necessary if the suction cannot be coupled to the tap, aeration can be much reduced, if not altogether avoided, by the simple expedient of fitting to the tap a piece of hose reaching the bottom of the tub. If the pump be carefully operated so as to avoid sucking air, the tub being always about half full, and splashing and froth be avoided, there will be but slight exposure to air. Here, also, the delivery must dip to the bottom of the cask to be filled. In this case, it will be well to add the bisulphite to the wine in the tub, preferably in occasional small lots.

We have seen (p. 427) that Laborde does not fear aeration *provided the wine receives, immediately afterwards, the necessary dose of* $SO_2$. Unless the wine be exceedingly liable to casse, these means of minimizing aeration will suffice.

Wines cured of liability to casse are often difficult to handle; their mucilaginous nature and the trouble in fining and filtering has been pointed out (p. 427). This usually corrects itself after a rest of some months or a year. They are also rather prone to colour instability, a defect of less gravity with our dark, full-bodied wines than with the

* A wine which is even fairly liable to casse may escape trouble at the first racking if this be early, owing to the protection from air afforded by abundant $CO_2$.

† *R. Vit.*, XLV., p. 320, 16th November, 1916.

lighter-coloured wines of France, yet certainly worth noting. According to Laborde*:—

Notwithstanding the destruction of oxydase . . . . which converts the faulty wine into a normal one, its colour retains a greater sensitiveness to air than that of a wine which has always been sound. . . . In the former, sedimentation or precipitation of tannoids is always more rapid than in the latter, even after bottling. This may be explained by Duclaux's theory of coagulation of substances which have aged prematurely. Perhaps, also, aldehydation may play a large part.

Similar changes are observed in connexion with attempted artificial maturation by heat in contact with air, or by hydrogen peroxyde. The ageing of the colour, which at first seems satisfactory, usually has a deferred and too pronounced action. After a few years, wines thus treated are altogether too much worn.

To delay the decolouration of wines cured of casse, it is well to add $SO_2$ in small quantities, but fairly frequently, whilst they are in hogsheads, and finally before bottling. An addition of tartaric acid also helps to fix colour by releasing it from potassic combination, which is more prevalent than usual, owing to portion of the tartaric acid of the grape being burnt up by the botrytis fungus.

## Appendix.

### TABLE SHOWING THE CORRESPONDENCE OF SOME METRIC AND ENGLISH WEIGHTS AND MEASURES.

In the foregoing pages, quantities of $SO_2$ have been expressed in centigrammes per litre, this being the most concise and convenient way. In order to permit rapid conversion to English standards, the following table has been compiled.

It may first be explained that centigrammes per litre are identical with parts per 100,000. They are likewise identical with grammes per hectolitre.

| Centigrammes per litre = parts per 100,000. | Grains per gallon. | Ounces (avoirdupois) per 100 gallons. |
|---|---|---|
| 1 | ·7 | ·16 |
| 2 | 1·4 | ·32 |
| 3 | 2·1 | ·48 |
| 4 | 2·8 | ·64 |
| 5 | 3.5 | ·8 |
| 6 | 4·2 | ·96 |
| 7 | 4·9 | 1·12 |
| 8 | 5·6 | 1·28 |
| 9 | 6·3 | 1·44 |
| 10 | 7·0 | 1·6 |

It should be remembered that fresh bisulphite of potash contains practically half its weight of $SO_2$. It follows that 5 centigrammes per litre of $SO_2$ are equivalent to .8 ozs. of $SO_2$ per 100 gallons, or to 1.6 ozs. of bisulphite of potash per 100 gallons.

Bisulphite soon loses $SO_2$ on keeping—after some months' storage the loss may be considerable, especially if it be not kept in air-tight tins or bottles.

*(To be continued.)*

* *R. Vit.*, XXXII., p. 710, 23rd December, 1909.

# WORLD'S POULTRY CONGRESS,

*By A. V. D. Rintoul, N.D.D., Chief Poultry Expert.*

(Continued from page 310.)

## Hygiene and Diseases.

Prof. Dr. J. Poels recommended that State control be adopted, and delegated to veterinary inspectors, particularly with regard to the following:—

Tuberculosis.
Klein Disease (typhoid) and White Diarrhœa.
Cholera.
*Pestis gallinarum.*
Diphtheritis.
Coccidiosis.

As regards export of birds, he recommended that the Government of each country should take measures to prevent the export of sick, or suspected poultry; and that poultry originating from countries which refuse to comply with this request be not allowed to be imported into other countries. No poultry to be exported without previous inspection, and the Government to issue a certificate of health.

Authority is also necessary to prohibit the import and transit of poultry originating from a country or part of a country where an infectious poultry disease prevails.

It would seem from the foregoing that Australian methods are far in advance of the Old World methods, because not only the Inter-State inspection exists, but also various areas of a State may be quarantined for any particular trouble, such as roup, diphtheritic roup, chicken cholera, tick, and tick fever.

Dr. J. R. Beach, of the University of California, drew attention to the close relationship between some of the poultry ailments, and suggested the following classification:—

*Chicken pox, or contagious epithelioma,* manifested by the formation of small wart-like tumours on the comb, wattles, or skin of the head.

*Canker, or avian diphtheria,* is manifested by the formation of masses of adherent cheesy exudate on the mucous membrane of the mouth or eyes.

*Colds and roup* are manifested by a viscid discharge from one or both nostrils, which has a tendency to collect in the nasal sinuses, where it undergoes rapid transformation into a cheesy mass, causing marked swelling of the face beneath the eyes.

The sole etiological factor of chicken pox is generally accepted to be a filterable virus; but in regard to canker this point is not so definitely settled. In no case has any one species of organism been isolated which could unquestionably be demonstrated to be the special causative factor. A close relationship between chicken pox and canker or avian diphtheria has often been noted. In 1913, Hadley and Beach reported success in immunizing fowls against chicken pox by injecting under the skin a suspension in sterile salt solution of scraping from lesions on the

comb and mucous membrane of diseased birds; and, in 1920, vaccine for 300,000 birds was furnished by the California station.

*Avian Tuberculosis* has been noted in the United States since 1896, and is difficult to diagnose in the living animal except in an advanced stage; negative results were obtained from the sub-cutaneous test with tuberculin from the human variety of organism, and no better results were obtained from avian tuberculin. In 1913, Van Es and Schalk obtained good results from an extradermal tuberculin test for chickens. This test was made by injecting one-twentieth of a cubic centimetre of a 50 per cent. solution of concentrated tuberculin prepared from the avian variety preferably into the wattle. The injection was made as near the surface of the skin as possible. A reaction was noted by a swelling of the wattle in which the injection was made, and this usually occurred most pronouncedly 48 hours after injection. Comparative tests with avian and bovine tuberculosis showed the former to be more reliable.

*Fowl Typhoid, or Infectious Leukemia.*—This was first studied by Moore in 1895, who isolated the organism, *B. sanguinarium,* and the disease produced was called Infectious Leukemia. The name was selected because an increase of white blood corpuscles and a decrease of red corpuscles had been regularly observed, and the disease is now known on both the Atlantic and Pacific coasts. In 1914, Smith and Tentweek reported a comparative study of the fowl typhoid bacterium and the bacillus of typhoid in man. They found that, although these two organisms have many features in common, particularly their action on carbohydrates and their agglutination affinities, they differed in some essential features, and were therefore distinct.

Hadley considers *B. sanguinarium* (Moore) to be identical with an organism earlier isolated by Klein, and named by him *B. gallinarium,* and therefore prefers to use this name instead of *Bact. sanguinarium* (Moore).

*Fowl Cholera.*—This was first reported by Salmon in 1880. Although satisfactory methods for bacteriological examinations were undeveloped at that time, there is little doubt that the disease was identical with fowl cholera. His experiments at the time showed that the virus could be cultivated and the disease transmitted by inoculation, or by the confinement of healthy birds on ground previously occupied by diseased fowls.

Fowls recovering from a mild attack of the disease were observed to be insusceptible to subsequent infection. Inoculation with minute amounts of virus produced only a local reaction, from which they soon recovered. Such fowls were found to be insusceptible to subsequent inoculation with larger amounts of virus. It was therefore concluded that fowls could be immunized against fowl cholera by vaccinating them with minute quantities of virus. No definite method of preparing such a vaccine, however, was developed. In 1902 an outbreak occurred amongst geese in Rhode Island, cultures of this organism proving fatal to geese, ducks, rabbits, and pigeons, but not to chickens. The disease died out soon after the institution of sanitary control measures, which consisted principally of dividing the geese into small units, and removing the healthy birds to new ground.

In 1904, Ward reported investigation of an outbreak in California, which was successfully controlled by the employment of sanitary measures, and by replacing the drinking water with a 1-2000 solution

of mercuric chloride. Later, in 1910, Hadley gave daily subcutaneous injections of 5 per cent. solution of carbolic acid with success.

*Bacillary White Diarrhœa of Chickens.*—In 1899, Rettger, of Yale University, and in 1907, Rettger and Harvey, isolated the causative organism, said to belong to the colon-typhoid hog cholera group, and the following year it was confirmed that the source of infection was the hen that laid the egg. The organism was called *Bact. pullorum.* It was isolated from the yolks of hatching eggs, and the ovaries of hens. In 1911, it was found that infection from chick to chick was non-communicable after they are three or four days old. The female chicks which survive often harbor the infection, and become bacillus carriers. Further investigations in 1919 left the conclusion probable that the male bird in the breeding pen might transmit the infection.

### "KEEL" OF DUCKLINGS.

In 1918, Rettger investigated a fatal disease amongst young ducklings, commonly known as Keel, and resembling bacillary white diarrhœa of chickens. The causative organism was called *B. anatum, N.S.* This organism has been isolated in pure culture from ovarian and abdominal cysts of breeding ducks. It is quite probable therefore that the disease is transmitted by breeders through infected eggs, in the same manner as bacillary white diarrhœa.

### BLACKHEAD, ENTERO-HEPATITIS, OR TYPHILITIS OF TURKEYS.

This was first studied by Smith in 1894, who ascribed the cause of the disease to a protozon, Amœba meleagridis, which was found in the walls of the cæca and in lesions of the liver. Smith classified it as an Amœba because it resembled that species of protozon more than any other. Cole and Hadley claimed that blackhead was caused by coccidia, and that the Amœba of Smith was merely one stage of the life cycle of the coccidium. Further investigation by Smith in 1915 refuted the coccidial theory, and confirmed his original observation regarding Amœba meleagridis. His experiments also showed that the infection is either not transmitted at all, or only under exceptional circumstances by turkeys in the early acute stage of the disease, but is readily transmitted by exposure to infected ground, or by older birds from infected flocks.

Whilst the disease has been given a vast amount of study, comparatively little concerning practical methods for its control has been brought out, but some success has been met with by feeding a restricted grain ration with an abundance of sour milk, particularly in the case of turkeys raised in confinement.

### COCCIDIOSIS OR COCCIDIAL ENTERITIS OF CHICKS.

Meyer and Crocker, in 1913, found that simple isolation, cleaning, and disinfection were the most dependable methods of treatment, and Dr. Poels found that (as in case of blackhead) sour milk was the best system of feeding.

### BOTULISM IN POULTRY.

It has been proved that "limber neck" may be produced by the toxin of *bacillus botulinus.* The term limber neck refers only to the

phase of trouble manifested by paralysis of the neck muscles, and prostration. It was reported in 1921 that forty-two outbreaks had been recognised in California during the last twenty years—643 birds out of a flock of 800 died in four days.

All outbreaks reported were traced to the feeding of kitchen refuse consisting of spoiled canned vegetables, and in consequence botulinus antitoxin was administered to all persons who have partaken of the suspected food.

### Favus.

The causative agent was found by Beach and Halpin to be the fungus *Achorion Schonleinü*. Favus is primarily a wound infection disease of the unfeathered parts of the head, and cannot be transmitted by feeding or intravenous inoculation with the fungus. Ointment made up of formalin and vaseline was found to be preferable to lysol, tincture of iodine, &c.

### Parasitic Infestations.

*Lice.*—Bishopp and Wood found, in 1917, that sodium fluoride was the best destroying agent; used as a powder, one application has been found to completely destroy all lice present.

### Intestinal Round Worm—*Ascaris inflexa* (*Heterakis perspicillum*).

Tests were made by Herms and Poels with powdered areca nut, powdered pomegranate root bark, turpentine, gasolene, iron sulphate, and tobacco—the most effective was found to be tobacco. Finely chopped tobacco stems were steeped in water for two hours, and the liquid mixed with the mash and fed to birds that had been starved for 24 hours previously. This was followed by a solution of epsom salts. The worm eggs in the soil of the poultry-yard were destroyed by a 1-1000 solution of bichloride of mercury.

Later experiments in 1919 and 1920 were made with finely ground tobacco, or tobacco dust, which was mixed in the mash at the rate of 2 per cent., and fed daily for three or four weeks. This amount of tobacco was found to have no ill effect on the egg production of the laying hens, nor to retard the growth of young stock.

Horton, in 1916, reported success by the use of either oil of chenspodium, or the plant (*chenopodium anthelminticum*) from which this oil is derived. The plant was fed green, or else chopped up and mixed with the mash. Another method was to make an extract of the plant by soaking it in gasoline for three or four days, and then add the gasolene to the mash, using about 4 c.c. for *each* bird. The oil itself, when used, was added to the mash at the rate of 4 c.c. for 12 birds. (This oil is extensively used for the eradication of round worms in young puppies.)

### Tape Worms.

It was not until 1916 that Gutberlet demonstrated that the cystoceroid stage of the tape-worm (*Choanotænia infundibuliformis*) occurs in the common house fly (*Musca domestica*). Flies fed on eggs of the tape-worm were said to develop cystoceroids, and in turn chicks fed on these flies developed the worm; but experiments with two other tape-worms

(*Davainea cesticillus* and *Davainea tetragona*) gave negative results. Further experiments in 1919 revealed the fact that another tape-worm (*Hymenolepis carioca*) may be transmitted to chickens by the stable fly (*Stomoxys calcitrans*).

This knowledge regarding the mode of transmission should contribute towards effective means of controlling the trouble.

### GAPE-WORM (*Syngamus trachealis*).

Experiments in 1920 by Waite show that these parasites are transmitted by earth-worms. Chickens and fowls fed on worms from infected yards became infected, but the parasites were not transmitted to healthy chickens by feeding gape-worms, nor by confining them with infested chickens. The important feature of control is to prevent chicks from obtaining earth-worms from contaminated soil.

### LEG WEAKNESS IN CHICKENS.

Until recently, it has been concluded that this is due to lack of exercise, over-feeding, or the absence of green feed. In 1918, Osborn and Mendel were successful in rearing a number of affected chickens, after roughage, in the form of paper pulp, was added to the ration.

Feeds rich in vitamines, such as butter, fat, yeast, green cabbage, green clover, and orange juice, did not, in the absence of roughage, prevent the development of leg weakness. Plenty of exercise and green feed also failed in the absence of the roughage, which was found most suitable in the form of paper pulp.

(*To be continued.*)

## A CHEAP PEN FOR SINGLE TESTING HENS.

*By W. C. Rugg, Poultry Foreman, Werribee State Farm.*

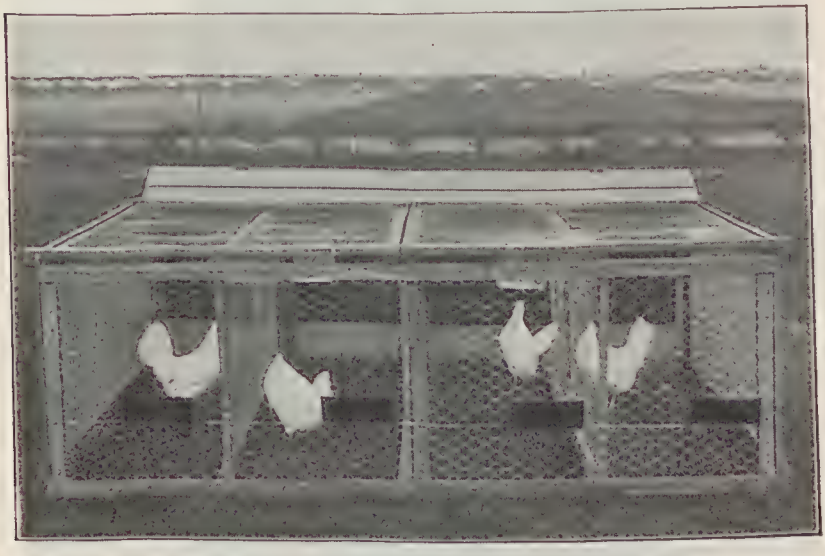
To lay the foundation of a profitable flock of birds for egg production, it is necessary to determine accurately the individual capability of each bird to be used in the breeding pen. For this purpose, trap-nests of various kinds have been used more or less successfully, but the single pen system is undoubtedly much superior.

To many poultry breeders the drawback to this system has been the high cost of erecting the required number of pens. In order to overcome this difficulty I have designed a coop, which, I feel sure, will appeal to every poultry breeder for its usefulness, simplicity and low cost of construction.

As will be seen by the illustration, it consists of a coop for the single penning of 4 birds; it is 8 feet long, 2 ft. 10 in. wide, 3 feet high in front and 2 ft. 6 in. at the back, and is partitioned off into four divisions, each 2 feet wide.

Running out from these partitions is a set of five hurdles 6 feet long and 2 ft. 6 in. above the ground with another hurdle 8 feet long and 2 ft. 6 in. above the ground across the front to complete the enclosure; the whole is covered with a wire netting frame, to insure each bird remaining in its own compartment, and each compartment contains 6 square feet under cover and 12 square feet in the yard. Thus, each bird has 18 square feet, which is equal to the space allowed in the single pens used in the Burnley competition and at the Research Farm, Werribee.

The hurdles forming the yards are held in position by hoop iron sockets attached to the coop into which the projecting ends of the rails are inserted, and the corners of the yards are held securely by loops of wire through which a wire pin is passed. The size of the coop has been limited to accommodate 4 birds, so that with very little time and labour it may be detached and re-erected on fresh ground.



**Front View of Pen.**

Material required for a coop to single test 4 birds:—

88 ft. 3 in. of 2 x 1 hardwood.
42 feet of weatherboard.
65 feet of 16-gauge wire.
3 square yards wire netting.
4 ft. 8 in. of 1 in. hoop iron.
2 pairs of small hinges.
50 square feet of ruberoid, 2-ply.
4 kerosene tins for nests.

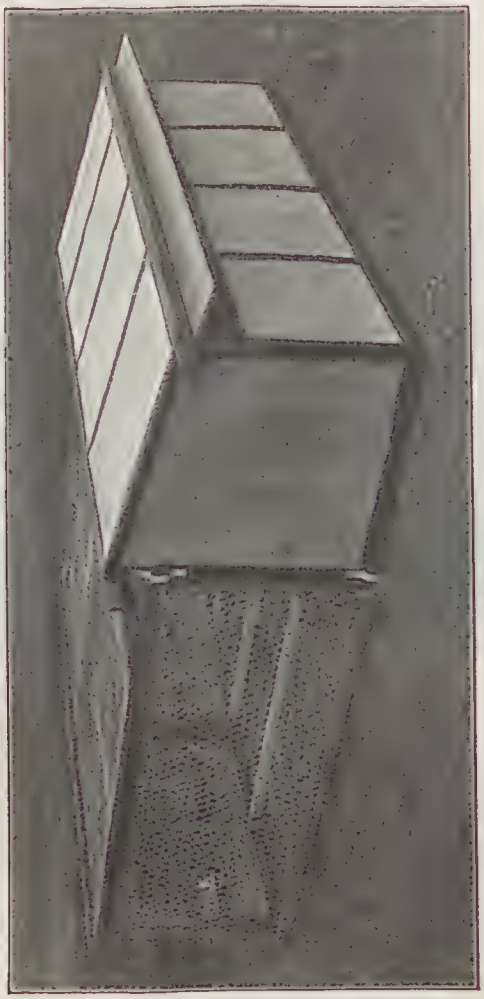
Material required for the hurdles:—

150 feet of 2 x 1 hardwood.
36 yards of wire netting 3 feet wide.
1 kerosene tin to cut 4 feed troughs.

### METHOD OF CONSTRUCTION.

Cut up the 2 x 1 hardwood as follows:—

2 pieces 9 feet long.
3 „ 8 feet „
2 „ 2 ft. 11 in.
3 „ 3 feet.
2 „ 2 ft. 5 in.
3 „ 2 ft. 6 in.
5 „ 2 ft. 8½ in.
2 „ 2 ft. 7½ in.



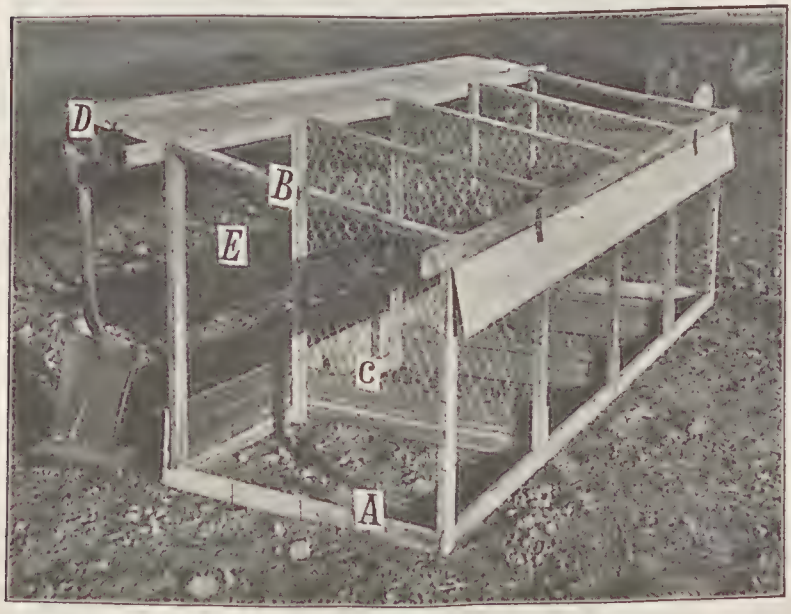
Side View of Pen.

Then cut the weatherboard into 4 pieces 8 feet long, and 3 pieces 2 ft. 8½ in.

To make the front of the coop, lay out one of the 9 feet lengths of 2 x 1, and one of the 8 feet pieces, 2 ft. 8 in. apart; nail a 2 ft. 11 in.

piece at each end of the 8 feet piece, and to the 9 feet piece 6 inches from the end and one inch from the top edge; next lay the 3 pieces of 3 feet at equal distances between these two and nail them on; turn this frame over and nail on a piece of 8 feet weatherboard just above the bottom batten; this completes the front frame of the coop.

To make the back, lay down 2 8-feet lengths 1 ft. 7½ in. apart, then lay a piece of 2 ft. 5 in. at each end, and the 3 pieces of 2 ft 6 in. at equal distances between the first two, mark them and scarf out the pieces to make a flush joint to which to nail the ruberoid. The 9 feet batten is to be nailed at the top of these short pieces, allowing 6 inches to project at each end; to it hinge an 8-foot piece of weatherboard to complete the back frame of the coop. This weatherboard is used as a ventilator board in hot weather.




**Showing how Back Portion may be Constructed.**

Now stand these two frames up and join together at the bottom with one of the 2 ft. 7½ in. pieces, A, at each end; then nail on the 5 pieces of 2 ft. 8½ in., B, to carry the roof, keeping them flush with the top rails of the frames; then take the 3 pieces of weatherboard 2 ft. 8½ in. long, C, and nail on to make the bottoms of the three partitions; complete these 3 partitions with wire netting. Next, take the two remaining pieces of weatherboard, D, join together by nailing on 3 cleats, and hinge on to the top of the front of the coop; this will rest on the hurdles of the yards and act as a verandah to prevent rain beating in on the birds; it is also convenient to lift up to enable the attendant to gather the eggs, to fill the water pot, and to catch the birds if necessary. The 6-inch pieces of batten projecting at each end of the coop are used as hand holds when it is desired to move the coop.

Next take the 16-gauge wire, E, and put up 3 rows at each end and the full length of the roof, about 8 inches apart, and 2 rows along the back at equal distances apart; these wires are to support the ruberoid and to prevent it sagging, and should be stretched fairly tight. Then cut 7 pieces of hoop iron, 8 inches long, bend these into the shape of a socket to receive and hold in position the projecting ends of the rails of the hurdles. Nail one of these sockets on to the left hand side of each of the centre partitions at the height of the hurdle, and 2 more sockets on the outside of each end of the coop at the proper distance to receive the top and bottom rails of the outside hurdles. The ruberoid can now be securely nailed on to the roof, sides and back.

The nests, made from kerosene tins, should be hung on the wire netting partition nearest each end, and the bottom of the tin should be 16 inches from the ground. The perches should be made of 2 x 1 hardwood on the flat the full width of the compartment and should have a hook in each end, so that they may be hung on the wire netting partitions, and easily removed, when necessary, for examination for vermin. These perches should be hung 18 inches from the ground and 14 inches from the back of the coop.

All perches should be given a coat of hot tar to fill up any cracks in the timber to prevent vermin from breeding there.

The floor of the coop should be covered with scratching material to a depth of 4 or 5 inches: Cocky chaff or short straw is best.

The timber for the hurdles should be cut as follows:—

| | | |
|---|---|---|
| 1 | piece of | 2 x 1 8 ft. 2 in. |
| 1 | ,, | ,, 7 ft. 10 in. |
| 7 | pieces | ,, 6 ft. 3 in. |
| 3 | ,, | ,, 6 feet. |
| 5 | ,, | ,, 2 ft. 6 in |
| 8 | ,, | ,, 2 ft. 9 in. |

One end of each of the 8 pieces of 2 ft. 9 in. should be pointed, so that they can be easily driven into the ground.

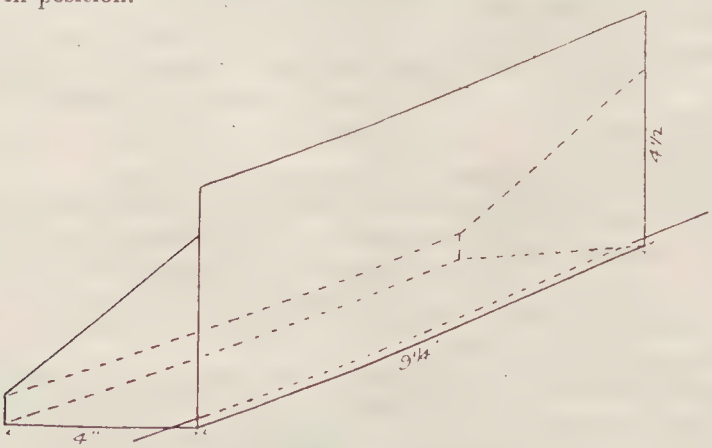
To make the hurdles lay the 8 ft. 2 in. and the 7 ft. 10 in. lengths 2 ft. 2 in. apart. Then take 3 pieces of 2 ft. 9 in. and nail one to each end of the 7 ft. 10 in. piece and one in the centre, then nail these to the 8 ft. 2 in. piece, allowing 2 inches to project at each end. This hurdle is to go across the ends of the yards. Then take 2 pieces of 6 ft. 3 in. and lay them down 2 ft. 2 in. apart; nail a piece of 2 ft. 9 in. to the right hand ends; next take a 2 ft. 6 in. piece and nail on 3 inches from the other ends; these projecting ends of the top and bottom rails are inserted into the hoop iron sockets attached to the left hand side of the coop. Take two more pieces of 6 ft. 3 in. and proceed as before, but nail the 2 ft. 9 in. piece to the left hand ends; this hurdle fits into hoop-iron sockets attached to the right hand side of the coop. Next lay out a 6 ft. 3 in. length and one of 6 feet 2 ft. 2 in. apart, and nail a 2 ft. 9 in. piece on the the two ends, and a 2 ft. 6 in. piece to the end of the 6-ft. piece and 3 inches from the end of the 6-ft. 3-in. piece; the end of this rail is inserted into the hoop-iron socket in one of the partitions, and the bottom of the hurdle is held in position by two cleats of wood nailed to the bottom of the coop. Three of these hurdles are required.

To hold the hurdles together at the corners a neat fastening can be made as follows:—Bore two small holes through the upright batten of one hurdle 9 and 10 inches respectively from the top, and one hole through the upright of the other hurdle 9½ inches from the top. Take three short pieces of 16 gauge wire and bend them into the shape of three hairpins; push the double end of one through each hole (leaving a loop ¼-inch in diameter), bend the ends over and secure with a small nail to prevent them pulling out. When the hurdles are erected in position these loops will be in line; through the three loops pass a pin made of No. 8 fencing wire, or else a 3-inch nail; this will hold the corners securely together.

Cut the timber for the hurdles to cover the yards as follows:—

Four pieces of 2 in. x 1 in., 5 ft. 2 in. long.
Two pieces of 2 in. x 1 in., 4 ft. 2 in. long.
Two pieces of 2 in. x 1 in., 4 feet long.

Make these into two hurdles, one 5 ft. 2 in. by 4 ft. 2 in., and the other 5 ft. 2 in. by 4 feet. Cover all hurdles with wire netting. These hurdles do not require any fastening as their own weight will hold them in position.




**A Feed Trough for the Pen.**

### FEED TROUGHS.

Four feed troughs can be cut from one kerosene tin. The bottom of the trough should be cut 5 inches to allow of 1 inch being turned up to make the front, a piece of No. 8 fencing wire should be passed through a hole punched at each end of the trough at the angle.

A piece of wire netting should be cut out large enough for the trough to be fitted in, and the No. 8 fencing wire fastened to the netting. The trough will then fold outwards so that feed can be put in, and its own weight should cause it to fall back into position.

Water vessels may be hung under the weatherboard verandah where they will be sheltered from the sun's rays, and be in a position convenient for filling.

# BROWN ROT OF STONE FRUITS.

(*Sclerotinia cinerea* (*Bon.*) Schr. Monilia.)

*W. Laidlaw, B.Sc., Biologist, and C. C. Brittlebank, Plant Pathologist.*

During the past season a series of experiments were carried out at Bairnsdale in the peach orchards of Mr. C. Goodman, and while we believe it premature to give any definite pronouncement on a single season's experiments, still some of the sprays were so successful that we consider it will be advantageous to growers of stone fruits if we give a short description of the disease, and a *résumé* of the experiments.

Brown rot is probably the most destructive disease of peaches, plums, cherries, and kindred fruits. Apples, pears, and quinces are also attacked, though not to the same extent in Victoria.

Brown rot attacks the twigs and flowers, but it is most evident on the fruits as they approach maturity. It first appears on the fruit as small spots, which enlarge rapidly. As the decay advances, small grey tufts appear near the centres of the original spots and spread very rapidly, covering the whole of the fruit in from 30 to 48 hours. If fruits touch each other the disease spreads from the points of contact until the whole bunch is affected. Diseased fruits may remain on the trees throughout the winter as "mummies," or they may fall to the ground and shrivel up, resembling the "mummies" on the trees.

On the blossoms the disease first appears as a brownish discolouration, giving the flower a frosted appearance. The disease spreads rapidly, and the flowers fall off as a rotten mass, carrying contagion to everything in their path. From the flowers the disease may spread to the twigs, which are also often affected directly from diseased fruits, especially where wounds are found.

The casual fungus is carried over the winter in the mummified fruits, in the cankers on the branches, and in the bud scales. If a "mummy" be examined in the spring time, very small stalked discs, resembling very small toadstools (ascophores), will be found; these furnish the spores for the spring infection.

In attempting to combat the brown rot, all twigs and branches showing cankers must be removed. These, along with all mummified fruits, whether on the ground or remaining on the trees, should be collected and burned or buried so deeply that cultivation will not disturb them. Pollock has shown that the sclerotia of the fungus causing the disease may remain alive for at least ten years; it is therefore good practice to destroy all diseased fruits by fire.

## Experiments.

The season 1920-21 in the orchards at Bairnsdale was a disastrous one, over 75 per cent. of the peaches being destroyed by brown rot. Our first work was to collect all the "mummies" and to remove as far as possible all twigs and branches showing cankers and to burn all the diseased material.

The following sprays were used on 28th July, 1921, when the trees were quite dormant:—

Commercial lime sulphur, 1 in 9.
Copper soda, 6 : 9 : 40.
Bordeaux mixture, 6 : 4 : 40.
Neutral copper acetate, 3 lbs. to 40 gallons.
Sopper sulphate, 1 in 10.

(The above sprays were again used when the buds were showing pink.)

Commercial lime sulphur, 1 in 20.
Copper soda, 3 : 4½ : 40.
Bordeaux mixture, 3 : 2 : 40.
Neutral copper acetate, 3 lbs. to 60 gallons.

Copper sulphate was not used at this stage, atomic sulphur 1 in 10 being used instead.

The third spray was used three or four weeks before the fruit was ready for picking. Commercial lime sulphur 1 in 30 and 1 in 40 and atomic sulphur 6 lbs. to 60 gallons being the sprays used.

In some cases, namely with the copper soda, Bordeaux and copper acetate, an extra spraying with self-boiled lime sulphur 8.8.50 was given five weeks after the second spray.

The varieties treated were Pullar's cling, 66 trees; Tuscans, 293 trees; Goodman's Choice, 38 trees.

### Results.

With commercial lime sulphur we got the best results, there being no brown rot, no leaf injury, and the trees were entirely free from peach aphis. Bordeaux and copper soda with the different third and fourth sprays gave very good results, so far as brown rot is concerned, but the trees had to get an extra spraying for peach aphis.

Copper sulphate and copper acetate were the least effective.

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We wish to express our appreciation of the work done and assistance rendered to us by Mr. L. Pilloud, Orchard Supervisor. We are indebted to him for the practical application of the various sprays, and also for the very careful records taken of their action on the control of the brown rot.

## SECOND GRADE CREAM.

### TWO COMMON CAUSES.

(*By F. Fincher, Dairy Supervisor*).

A farmer always claims that his cream is a superfine article. Thus, when the grader thinks differently, and classes some of his consignments as first or second grade, he will invariably attribute the fault to the factory staff—never is he himself to blame! The factory wants only superfine cream; they may take the poorer quality when there is insufficient superfine to work with, but it is much more satisfactory to everybody when perfectly sweet cream is supplied.

From the time the cows are milked till the cream reaches the factory there are several ways in which the quality of the cream may be caused

to deteriorate, and, broadly speaking, dirt in some form or other is the root of the trouble. The dairyman may be fully aware of the injurious effects of cow-yard filth and other forms of dirt, but, unfortunately, he does not always realize that stale milk or cream is equally contaminating.

It is still all too common to see a milker working with dirty hands; while many do not yet realize the necessity for cleaning the udder and teats of each cow before milking. As much dust collects on the udder of a cow as on the neck of a horse; but where is the farmer who will not spend some time in grooming his horse before harnessing up? Yet, the same man will often milk his cow without first brushing or wiping the udder. The fact stands that, unless some such cleansing is done before each milking, the milk must be in some measure tainted. Of course, the milk goes through the separator, which is supposed to remove all dirt, but the dairyman, who depends on the separator to do to the cream what he himself should have done to the milk, will pay for his neglect when the cream drops to a lower grade. Unwashed udders and milking with wet hands cause loss to many a farmer every year—possibly to the price of a good cow—through reduced cream values.

In the subsequent handling of the cream, it is surprising again how many people will stir with a dirty stick, and be apparently unaware of the dirt. After separating, and before mixing it with the cream of previous milkings, cream should be cooled by standing the vessel containing it in cold water. Then, when it is put into the factory-can, it should be stirred, but not with a stick coated with stale cream. Stale cream is sour cream. Sour cream is full of bacteria life; and bacteria, whether from simple dirt or from over-sour cream, will turn a can of fresh cream into a second grade product within a few hours. The stick used for stirring cream should be washed after each using, the same as the milk strainer or separator bowl. A metal cream-stirring contrivance on the line of the elongated egg-beater would be the best of all, but whether of metal or of wood the stirring instrument should be scalded regularly.

The individual who stirs cream with the same stick for days in succession without once washing it, would make quite a fuss if asked to stir tea with a spoon which had not been washed after the previous meal. Yet why? A soiled tea spoon may offend only the sense of cleanliness in the drinker, while the dirty cream stick will cause trouble at the factory which will result in the owner of the cream getting cross about the grading; in addition, it will make the cream cheque smaller. Cleanliness in dairy work is at all times profitable.

# ORCHARD AND GARDEN NOTES.

*E. E. Pescott, F.L.S., Pomologist.*

## The Orchard.

### PRUNING.

Pruning operations will now be in full swing. In pruning the young trees, heavy pruning will be required in order to produce strong growths and a good frame, but as the tree advances in age the pruning will be reduced considerably. It should be remembered that strong, heavy

pruning results in wood growth, and that weak pruning steadies the tree, and promotes an even growth. When framing and building a tree, the former consideration is observed, and when the tree is coming into fruit bearing or is mature, it will be pruned according to the latter. Any operation that will cause the tree to produce less wood growth will induce the tree to become more fruitful, provided the tree be in a healthy condition; so that when trees are mature, pruning operations, as a rule, should not be severe, but rather the reverse.

Old fruiting wood, and dead and dying wood should always be removed, and aged spurs should be considerably reduced, in order to make them produce new growths. Crowded and overlapping laterals should be shortened back; fruit-bearing in the higher portions of the tree should not be encouraged; and due consideration should be given to the admission of light and air to all parts of the tree.

Where varieties of fruit trees are prone to bearing crops every second year, their lateral system should be pruned so that they will not produce too heavy a crop in the fruiting year; and at the same time they will produce wood in their fruiting year to give a crop in the subsequent season.

A model tree will always be light on its topmost leaders, bearing the major portions of the crop in the lower regions of the tree. The main point to be noted is that a heavy wood growth in the upper portion of the tree tends to reduce the bearing capabilities of the tree in its most useful parts.

## DRAINAGE.

The rains of winter will always show the necessity for draining orchards. Where under-soil drains do not exist, the trees are bound to suffer. If the damage is not immediately apparent, it will be later found that in some way loss will accrue. Either the tree will be weakened by the loss of roots through rotting, or it will be devitalized so that it will not carry a satisfactory crop of fruit. Too often surface drainage is relied on to remove the so-called surplus water. There should be no surplus water for surface drains. The water is only surplus or excess when it is in the soil. Two circumstances, and two only, permit of surface drainage. First, when it is necessary to carry away excessive stormwater; and, second, when it is practically impossible to find an outlet for under-drains, owing to the low-lying situation of the area.

The term "surface drainage" does not apply to open drains, which, owing to their depth, act also as soil drains; neither does it apply to graded surfaces which allow a more equitable distribution of water. Surface draining is usually applied to a system, whereby a considerable quantity of water is removed by gravitation before it enters the soil. Such a system cannot be too roundly condemned. As much water as can be obtained by natural means should be induced to enter orchard soils; and then whatever is in excess will be carried away by under drainage, provided that drainage, either natural or artificial, be in existence.

Where suitable drainage is not provided, the tree roots are compelled to remain in a few inches of surface soil. Their feeding area is thus extremely limited indeed; and when, at any time, rain-water does

filter and penetrate through the soil, it carries with it the soluble and other plant foods, below the reach of the tree roots.

Soil ventilation is only possible with a system of drainage, and air is as necessary to the roots of a tree as it is to the foliage. By the removal of the surplus water and the consequent admission of air into the soil, the soil temperature is rendered far more equable, warmer in winter and spring, and cooler in summer; and such a change must be beneficial to the trees.

Drainage is thus an essential for all orchard lands. When natural drainage occurs, the orchardist is fortunate; but whether natural or artificial, a system of drainage will always materially increase the crop of fruit, strengthen the trees, and considerably add to their term of life.

Drainage schemes should be carried out at the present season of the year. In closed drains, such drainage media as cinders, charcoal, stones, brushwood, timber, logs, or tile pipes may be used, but the latter generally give more satisfactory and permanent results. They are also less liable to silting up than any other material.

Drains should be placed into the clay, if this be not too deep. In any case, they should be below any possible interference from cultivating instruments.

### SPRAYING.

In order to keep in check such pests as Bryobia, scale insects, woolly aphis, and others, a strong and forcible spraying with lime sulphur or red oil spray should not be delayed any longer. The whole tree should be thoroughly wetted with the spray. A good, vigorous, and thorough winter spraying will place a large majority of the trees in quite a satisfactory condition of freedom from these pests for the whole year.

The lime sulphur spray is an excellent fungicide, and a strong winter spray will go a very long way in reducing any attack of the black spot fungus on either the apple or the pear. In addition, if the peach trees are sprayed at this time with lime sulphur, both peach aphis and peach leaf curl will be considerably minimised in the spring time.

## The Flower Garden.

Digging in the garden should be continued. Before digging, the beds should be given a top dressing of lime or stable manure, and subsequently these should be dug well into the soil. Care must be taken not to injure the roots of any shrubs, trees, or roses. Root cutting and root pruning will always dwarf any plant. In digging, it is not wise to discard any leaves, twiggy growths, or weeds. Unless they are required for the compost heap they should always be dug into the soil. Leaf-mould is especially useful in any garden, and where such plants as Azaleas, Rhododendrons, Liliums, &c., are grown, or for pot-plant work, it is exceedingly valuable. In forming the compost heap, no medium whatever should be added to help the rotting down of the leaves unless it be a little sand. Any chemical added will render the mould unsuitable for its special objects. The plants mentioned above strongly object to lime.

All shrubs that produce flowers on their young growths, including roses, should now be pruned. Care should be taken to distinguish between those shrubs that flower on the new wood and those that flower on the wood of the past season's growth. Those that flower on the new wood, and may now be pruned, are Lantana, Cestrum, Tecoma, Hydrangea, Plumbago, Erythrina (some species), &c., and those that should not be touched at present time are Spirea, Erythrina (some species), Pyrus Japonica, Weigelia, Prunus pissardi, P. Vesuvius, P. mume, Deutzia, Polygala, Ceanothus, &c. It is a safe rule in pruning shrubs to wait until they have flowered before pruning. This will certainly give the shrubs a somewhat ragged appearance in the winter, but it is the only way to secure the best flowering results.

All herbaceous plants, such as Salvia, Aster, Delphinium, Polygonum, Boltonia, Gaura, and Chrysanthemum, should be cut back, and, if necessary, lifted and "heeled in" in a temporary location for the winter. Plant out early Gladioli, Iris, and Liliums.

Continue digging, manuring, and trenching.

### The Vegetable Garden.

Seedlings from boxes or seed plots may now be planted out. Care should be taken that all vegetable beds are well raised and thrown up. By throwing up the soil, and thus deepening the paths and the spaces between the plots, the latter are well drained, and the soil is made considerably warmer. This will greatly facilitate the growth of the young plants.

Asparagus may be planted; sow seeds of carrots, parsnips, cauliflowers, onions, peas, broad beans, and tomatoes, the latter being forced on in a frame, so as to obtain good plants quickly.

## REMINDERS FOR AUGUST.

### LIVE STOCK.

HORSES.—The feeding and general management of horses recommended for July will also apply for this month. Horses, more especially young ones, running on low-lying country are liable to become affected with internal parasites. This will be recognised by the unthrifty and poor condition of the animals; in such cases medicinal treatment will be necessary. If the following lick be made available, it will not only be of great assistance in preventing serious invasion, but in cases where worms are not in large numbers, the repulsion of them from the intestinal tract will result:—

*Lick.*

20 parts salt.
10 do. lime.
1 do. sulphate of iron.

If possible, be with mares at foaling, so that the navel cord may be properly tied and thoroughly treated with antiseptic, and thus prevent that very fatal disease, navel or joint ill. Wash cord with one part of corrosive sublimate to 3,000 of water, and soon after paint with tincture of iodine. The iodine treatment must continue till the cord has completely dried up.

CATTLE.—Cows should still be rugged, but coverings should be removed frequently, in order to enable the animal to get rid of the old coat; or, better still, a good curry-combing may be given. Continue hay or straw. Look up treatment for milk fever in *Year-Book of Agriculture*, 1905, and treat cattle accordingly. Give calves a good warm dry shed. Give the milk to young calves at blood heat. Have feeding troughs or buckets clean. Don't over-feed. Feed regularly with regard to quantity and time. Provide a good grass run, or fine hay or crushed oats in a box or trough. Give a cupful of limewater per calf per day in the milk. The problem with many at the present time is how to rear calves without milk. This can be done very well by starting them on new milk for a fortnight, and then gradually substituting the milk with one of the calf meals on the market. To these it would be advisable to add two or three tablespoonfuls of cod liver oil. The following meal is in general use in Ireland:—Two parts, by weight, of oatmeal, 2 parts maize meal, 1 part pure ground linseed, all finely ground. Scald with boiling water, and allow to stand for twelve hours. Start with new milk, then gradually substitute skim and ¼ lb. daily of the meal mixture per head per day, gradually increasing to 1 lb. or more. In a month milk may be dispensed with altogether. The crushed oats, fed dry, have been found to give excellent results.

PIGS.—Supply plenty of bedding in warm well-ventilated sties. Keep sties clean and dry, and feeding troughs clean and wholesome. Sows may now be turned into grass run. If pigs are lousy dress with kerosene emulsion or sulphur and lard, rubbing well into crevices of skin, and disinfect sties. Worms are very prevalent at present, and may be treated by giving 2 to 10 grains of Santonin in form of pill, or from half to one teaspoonful of oil of turpentine in milk or castor oil.

POULTRY.—Yards should be turned over with a spade or fork, and sown down with rape or barley. Keep the breeders busy—straw litter with a little grain scattered about will make them exercise. Overhaul incubators; see that the capsule of thermostat acts properly; thoroughly clean lamps, egg drawers, and chimneys. Test machine for two days before putting eggs in. It is also advisable to have thermometer tested. When additional incubators are required, it is more satisfactory to keep to the one make.

## CULTIVATION.

FARM.—Second fallow where necessary for summer crops. If required, roll or harrow crops. Plant very early potatoes in forward districts. Sow mangolds. Apply slow-acting fertilizers, such as blood and bone manures, for maize.

ORCHARD.—Complete planting and pruning of deciduous trees. Watch for peach aphis, and spray with tobacco solution, if present. Prepare for planting citrus trees. Spray for woolly aphis with lime sulphur or red oil spray.

FLOWER GARDEN.—Finish digging and pruning of roses, &c. Leave pruning of shrubs till after flowering. Keep weeds in check; weed out seed beds. Divide and plant out all herbaceous plants, such as phlox, delphiniums, rudbeckia, &c. Plant out gladioli. Complete planting of shrubs. Mulch young plants.

VEGETABLE GARDEN.—Top-dress asparagus beds; plant new asparagus plots. Plant herb divisions, and potatoes. Sow cabbage, cauliflower, peas, carrots, beans, radish, and lettuce seeds. Sow tomato seeds in a hot frame. Finish digging.

VINEYARD.—August is the best month for planting vines (grafted or ungrafted). This should be actively proceeded with and completed before end of month. Scions for field grafting may still be preserved as detailed last month, or better still by placing them in cool storage. They should all be removed from vines before end of month, at latest. Conclude pruning and tie down rods. Where black spot has been prevalent, apply first acid iron sulphate treatment. Owing to the dry spring, black spot was not in evidence last season. The fungus is not dead, but dormant, hence preventive treatment must not be neglected. Leaflets dealing with black spot and its treatment will be supplied on application.

*Cellar.*—Rack again, towards end of month, wines which have as yet only been once racked (spring racking). Fill up regularly all unfortified wines. Clean up generally in cellar and whitewash walls, woodwork, &c.

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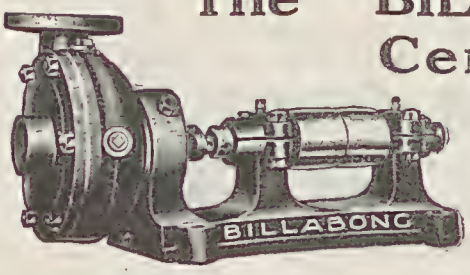


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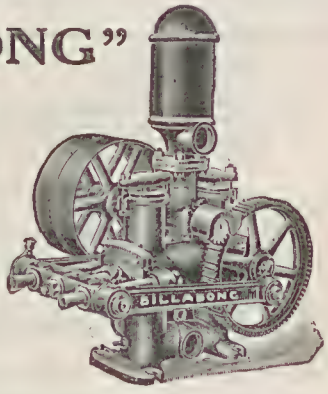


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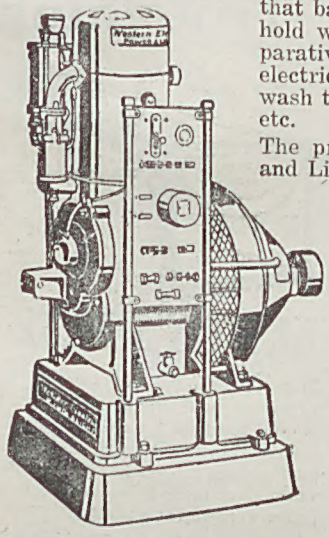

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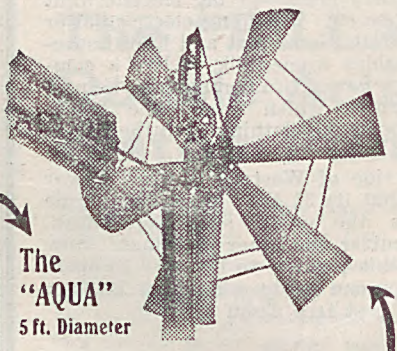

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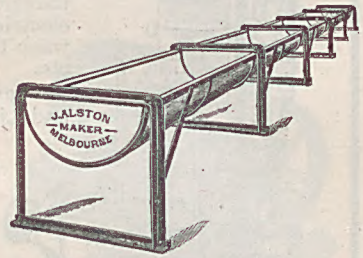


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